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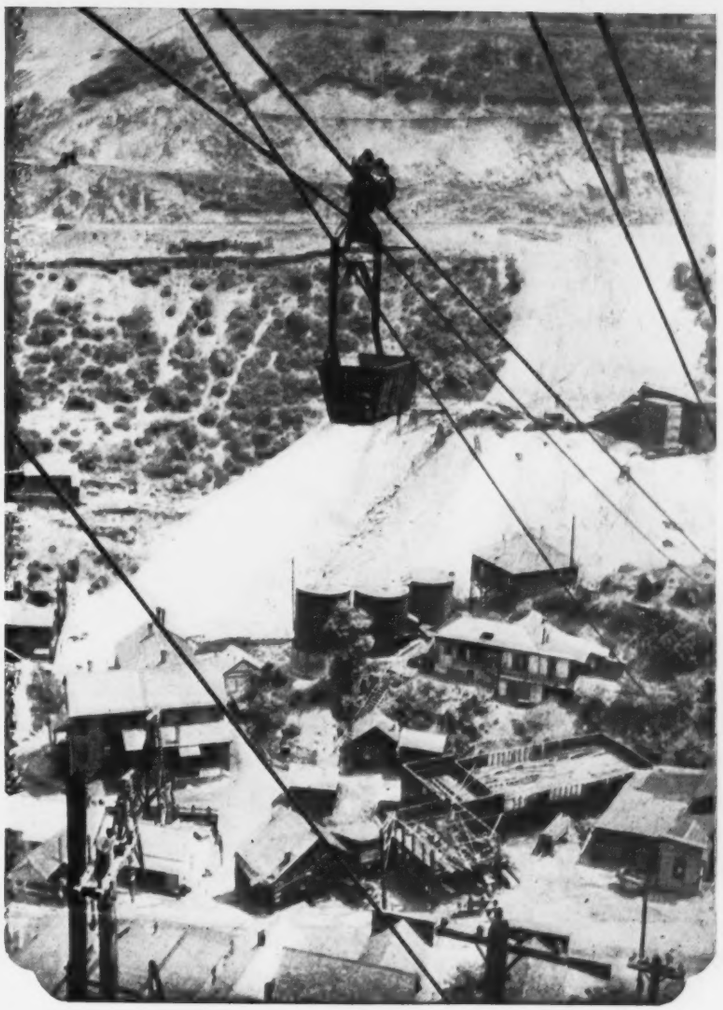


An aerial highway in upper Bingham Canyon, Utah

Tonopah, Nevada's Best-known Silver District

By Herman D. Budelman

Suggestions as to Selecting Flotation Reagents

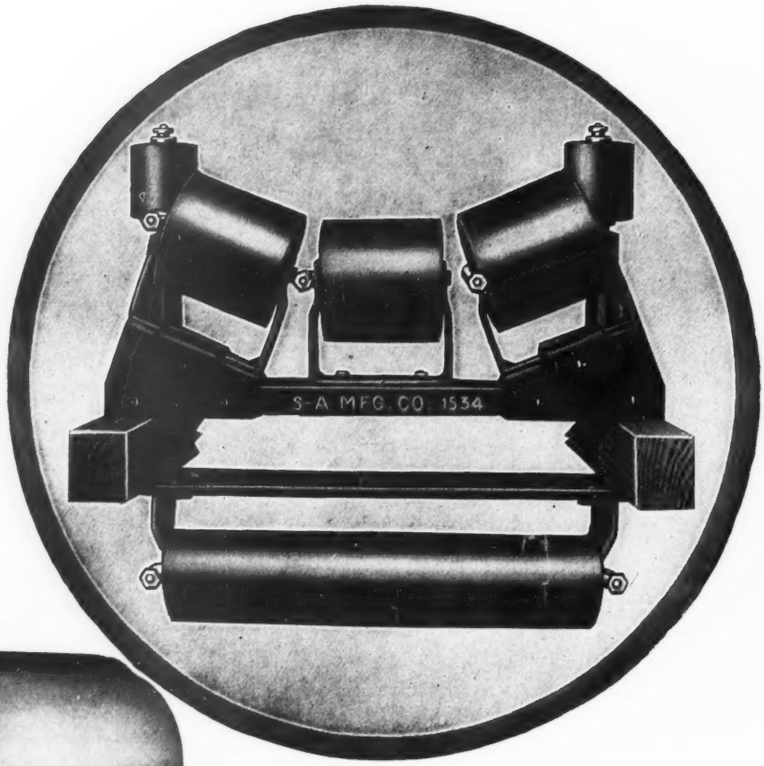
By H. E. Fredrick

A Record Blast with Liquid Oxygen Explosive

By F. W. O'Neil

Consumption of the Platinum Metals

By Jas. Lewis Howe



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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 118 | New York, July 5, 1924 | *Number* 1

A Crisis in Copper

INDICATIONS are that a marked cut is coming in the copper industry: whether it is to be a cut in prices or in production depends solely upon the producers themselves. If the current rate of production continues for the rest of the year, we would not be surprised to see prices drop off still further; if production is decreased, say, 25 per cent, prices may rise a few cents a pound.

Domestic mine production of copper in 1923, when general business conditions were considered excellent and consumption of all raw materials was much better than it is now or is likely to be in the coming months, averaged 123,000,000 lb. monthly. In the first five months of this year the average was 130,883,000 lb., and for May the production was 131,054,000 lb. Some companies have curtailed, but any such decrease is more than made up by other companies that feel that they must operate at capacity to make costs as low as possible, and by new producers. Conditions abroad are the same as in this country, some companies having curtailed and others having increased production.

We see little hope of any sudden improvement in foreign demand: at best it is likely to increase only gradually, as it has been doing in the past. Badly as it is wanted, foreign countries have not the money to indulge in any wild orgy of copper buying. Domestic demand has kept up wonderfully well, but has weakened in the last month or two. What else is to be expected when steel buying is only 30 per cent of capacity and when all the business barometer curves are pointing downward?

Many copper producers have kept up operations without making a profit, or actually taking a loss, hoping from month to month that demand would improve or that the other fellow would close down. To close down a mine completely is an expensive thing to do, but we feel that, unjust as it may be in some ways, the high-cost producers may be compelled to do this very thing. We can see no other solution if the demand does not increase. Were the copper industry administered as is the iron industry, a general policy of curtailment could be carried out. Pig-iron production is speedily adjusting itself to market conditions, says *The Iron Trade Review*. Moral suasion was tried on the copper producers this spring, and it has failed. Now, falling prices threaten something more drastic—for certain companies.

An "Open" Gold Market

PROPOSALS for the encouragement and relief of gold mining by means of a bonus or bounty are now recognized as outside the domain of practical politics. This is the impression gained from the proceedings of the recent meeting of gold producers at Grass Valley, Calif., at which the passing of the McFadden bill into oblivion was given brief attention. An alternative proposal is now being discussed. It was supported by three prominent speakers at the meeting —W. J. Loring, Governor Boyle of Nevada, and J. F. Callbreath. Each spoke with conviction against the present practice of the government in providing gold coins for use by jewelers and other fabricators who melt them. The gold miners feel that if they can sell their output directly to the manufacturer they will be able to obtain a higher price than by disposing of it to the government. Therefore, the recommendation is made that an "open" market for gold be established, so that the miners may get what they can over the standard price of $20.67 per fine ounce. This would be a most desirable result, since the adverse conditions under which the gold miner is working are well known. The only question, from our point of view, is whether the remedy is workable.

But would an "open" market be established solely by a law forbidding the melting of gold coin by jewelers and others? A consideration of the conditions under which gold is bought and sold for commercial purposes indicates that such an expedient would be ineffective. The amount of gold defaced or melted is small. The principal jewelers, who use large amounts of the precious metal, prefer the little 10 to 20 oz. bars of refined gold to coins containing base metal and more or less abraded. They can obtain these bars on presentation of gold certificates at the nearest U. S. Assay Office. Gold certificates are exceedingly plentiful these days; moreover, a Federal Reserve note or a national bank note may be exchanged for a gold certificate. Each one of these bars carries a charge, depending upon its value, which is paid by the purchaser. The interested reader will find a list of these charges on page 929 of our issue of June 7, 1924. Hence the purchaser does not obtain his gold exactly at the rate of $20.67 per ounce. Perhaps the corner jeweler may melt a gold coin now and then to provide himself with metal for repair purposes, but in the aggregate we do not think this is an important factor in gold consumption. Should he be forbidden to do this, what is to hinder him from melting down foreign gold coins? Recently we saw several hundredweight of Mexican pesos put into the melting pot in a silver refinery.

In the second place, of the $4,300,000,000 in gold lying in the vaults of our banks, a great proportion is bullion that has been melted from imported coin—from English, German, French, and other gold pieces. Hardly a week passes but several million dollars in gold coin is presented at the New York Assay Office by the banks, for conversion into bullion bars. Domestic gold production is only a fraction of the huge accumulation that has grown so rapidly in the last few years. The domestic miner has no claim to this imported metal; and it would be difficult to say that the owners should not do with it as they please. The twenty-dollar gold piece you may have in your pocket (if you are flush) at the congress may have been minted from gold mined in

F. P.

South Africa or in Russia as probably as from United States gold. On the other hand, England and Germany melt down United States coins if they have them, to give them their own stamp.

The gold miner really has an "open" market for his metal now; the sort of market he is advocating would not be open but restricted. In whatever action he finally decides to take, he should remember that it is vital for his own sake to try to do nothing which would disturb the gold standard. The maintenance of a gold standard is predicated on free and unhampered commerce in gold, regardless of who produces or handles it, and ready conversion of bullion into coin or vice versa.

Flotation Machine Design

IN HIS ARTICLE ON FLOTATION which appears in this issue, H. E. Fredrick makes some good points, though some of his theories may be questioned by other workers. One thing that he mentions is, we believe, well borne out in practice; that is, that even when using the "oil-less" reagents, a little pine oil or similar additive reagent does no harm and may improve the results, owing to the fact that it stabilizes the bubbles. The design of the machine may well be at fault when such bubble stabilization is required, and this leads us to question whether those who have done most of the work with the newer reagents have given sufficient attention to the flotation machines they are using. Have they not spent most of their time in varying the reagents to get the best results with a given machine which was designed for different conditions?

In the ordinary flotation machine, some, at least, of the mineral-laden bubbles must carry their load along a horizontal distance of two or three feet before they roll over the brink into the concentrate launder. When using a reagent that gives a very evanescent bubble, would it not be better to have a machine in which no bubble would have to travel horizontally more than, say, six inches, to deliver its load? We have in mind, for example, a cell of approximately triangular cross-section, whose sides slope inward, leaving an exit space for the bubbles at the top that is only a few inches wide. Has such a cell ever been tried in modern practice?

The Mining Journal of Mexico

IT IS WITH PLEASURE that we receive the first number of a new mining journal, which has appeared in the city of Mexico—the *Mining Journal of Mexico—El Mexico Minero.* In the old days of peace and prosperity Mexico supported its own mining newspaper—the *Mexican Mining Journal*—a live publication. It is a good omen that the publishers should have deemed the conditions satisfactory enough to warrant the issue of the first number of a new journal. It is appropriately published with parallel columns, on each page, of Spanish and English—the section headings also are bilingual. The leading editorial is on "Future Prospects," and observes that "It seems as though Mexico is on the eve of a new era, an era of tranquillity which will permit the free development of its economical forces, of its industry and agriculture, and above all an era which will be taken advantage of by the mining industry which forms the basis of its national wealth." May God grant it!

The same editorial later says:

"Amongst Mexico's best clients is to be found the United States. The geographical situation of both countries facilitates the exchange of their products. It can be justly said, therefore, that the prosperity of the one depends on the prosperity of the other.

"It may also be stated that the relations between both countries have seldom been so good as at present. Confidence in Mexico grows daily in the great northern republic, and as a logical and natural consequence, an increase of exchange of products and affluence of American capital is bound to come. All branches of Mexican economical life will be benefited by this confidence, especially mining interests, which only await the fructiferous shower of American gold to fulfill its promises."

The new journal has an artistic cover, and the contents indicate that a serious effort will be made to maintain a magazine of high grade. We wish the enterprise much luck.

An Iron Ore Myth

EITHER some one has been spoofing the St. Louis *Globe-Democrat* and the public in general, or that worthy newspaper is chaffing the rest of us. According to its leading editorial in a recent issue, there is a deposit of iron ore "in and near the Raccoon Mountains, in northern Alabama," that in "three great blanket veins of high-content iron ore stretches over an area estimated at more than 1,500,000 acres," containing no less than 50,000,000,000 (billion, not million) tons. "In other words," says the *Globe-Democrat,* "in one compact deposit, 400 miles from St. Louis, is twice as much iron ore as in all the other known deposits of the world. These Raccoon Mountain ores are not to be confused with others that have enabled an important metallic industry to flourish in the vicinity of Birmingham, Ala." It continues: "The magnitude of the amazing deposit, almost undeveloped as yet, is known to technical specialists, but scarcely a whisper has reached the general public."

Since this startling news arrived, the entire staff of geological reporters and iron ore specialists has been searching painstakingly for this amazing deposit of ore, but without success. There are lots of raccoons, however, they all agree, with a good chance for something in the nature of a skin enterprise. "Wasn't it Muscle Shoals and its unlimited power resources that the *Globe-Democrat* was thinking of?" asked one. "The weather was hot, and a newspaper editor might easily get confused, with all this convention stuff to handle."

"The location given is somewhat hazy," replied one Alàbama geologist who was asked. "It reminds me of a Cockney Englishman named Perkins whom my brother met in Algiers, and who ingenuously inquired if Charles 'knew his brother in America.' The place of abode of the Americanized Perkins was somewhat sketchily indicated as 'near Fullydulphiyah on Boston River,' the precise name being finally dug up and stated as 'Sarn Franchesko.' 'Raccoon Mountains' is about as accurately described, in respect to location, as was Perkins," he concluded.

Of all the news unearthed by these keen-scented sleuths in northern Alabama the bit that sounded most like 50 billion tons of ore was to the effect that, a year or so ago, a Chicago syndicate acquired (or so the rumor said) about 140,000 acres of mineral land, mainly coal and iron, and was to develop it with a $5,000,000 incorporation. Nothing has since been heard of the syndicate, however, and payments on some of the properties are long overdue.

Veindikes and Replacement Deposits

THE FACT that many mineral veins are intrusive veindikes is becoming more and more widely recognized. Other veins, of course, are not veindikes; there are many veins formed by replacement, along fissure zones. Many ore deposits, again, are without classifiable form, replacing their host-rock irregularly. To one who envisages even these replacement deposits, the conclusion must come that they are not due to any universal or widespread cause—to the action of meteoric waters or even to the action of the juvenile waters which emanate from consolidating igneous rocks.

Whoever is able to consider the time and space relation of ore deposits, and will take the trouble to do so, will demonstrate to himself beyond any doubt that the agents mentioned, long appealed to, are not possibly the principal agents of ore deposition. These time and space relations, as well as other relations, such as that of mineralogic vein types, and the sequence of metal succession, tie these replacement ore deposits closely to the veindikes, from which they differ in having been, before injection, more fluid and penetrant and hence more gaseous (aqueous) in composition. Pegmatites show precisely the same variation, from pegmatite veindikes to pegmatitic replacements on a large and small scale. It is indicated, indeed, that the ore magma is a variety of the pegmatite magma; and this magma may be called pegmatore magma, and contrasted with rock magma, which contains a less proportion of the volatile constituents.

From regions located antipodially to one another, evidence is being presented as to the occurrence of veindikes and deposition of ores from ore magmas—not waters. Dr. H. I. Jensen, writing in the *Queensland Government Mining Journal* in January of this year, says: "Our Queensland molybdenite quartz and wolfram quartz lodes are rather to be regarded as highly siliceous dikes, grading into pegmatite, than ordinary lodes. At Wolfram Camp, in the Northern Territory, also, the great Burns lode is pegmatitic in part, containing huge biotite crystals in association with nests of wolfram and chalcopyrite. In the writer's report on the Percyville field he has described scheelite-gold-monozite-bismuth-bearing pegmatite dikes, and has shown that the great dabs of gold found on that field came from the apex of pegmatite dikes, where these passed into quartz veins. This occurrence is very analogous to what Mr. Spurr has recorded in regard to the Alaska pegmatites."

Taking the long jump now to Cornwall, Mr. E. H. Davison, writing to the *Geological Magazine* of May, says: "It is now generally accepted that there is no essential difference between igneous intrusion and the deposition of the minerals which fill the deep veins. Both igneous rocks and deep veins were formed from magmatic material, their differences being due to successive differentiation and not to difference in origin."

The author describes Cornish ores which are veindikes, carrying tin, tungsten (wolfram), arsenopyrite, and other minerals, including quartz and orthoclase, and concludes that the evidence in Cornwall is that the sequence of geologic events which led up to ore injection was: granite intrusion, from which the residual magma formed aplite and pegmatite, and the residual magma from this formed the mineral veins.

Radio and Copper

THE Copper & Brass Research Corporation estimates that about two pounds of copper is required in the construction of a radio set. For this purpose the same authority estimates that radio manufacturers will use, in the next five years, five million pounds of copper annually. This amounts to about one month's production of the Nevada Consolidated (1923 production). Not so large, it will be said, but nevertheless it is significant of progress in the utilization of copper.

In 1900 the per-capita consumption of copper was 4.57 lb.; in 1910, it was 7.96 lb., and in 1923, the approximate per capita was 13.32 lb. Thus in twenty-three years the per-capita consumption of copper in the United States almost tripled that of 1900. Assuming a 50 per cent per-capita increase by 1930, the per capita would reach about 20 lb. Population in 1930, barring calamities, wars, and setbacks, might reach 120,000,000. The domestic demand by this running-leap approximation will be around 2,400 million pounds of copper at that time. The maximum production of copper was in 1916, when 1,928 million pounds was produced by domestic mines. Production in 1923 was 1,669 million pounds. The increase in the world's per-capita consumption is reflected by the world's production, which increased from 306 million pounds in 1885 to 2,089 million pounds in 1920, or at the rate of 50.9 million pounds per annum.

The radio industry is only one of many industries that contribute to the convenience and to the amusement of mankind. Like other industries, it demands its quota of copper. The spread of modern civilization which is penetrating many far-off communities augments the need for copper as well as many other metals.

Closed Down But Not Closed Up

TWO OF THE MEMBERS of the staff of *Mining Journal-Press* recently visited a mining property that had been closed down for months because the market price of the metal produced had dropped below that line in the curve at which profitable operation was possible. Prospects of early resumption seemed remote; but no spirit of gloom, pessimism, or discouragement was discernible. Everything was in the best of order, and, most remarkable of all, the mine labor had not deserted the property, but was marking time.

The engineer in charge, a man of proved ability, skill, and judgment, who knows the market for the mine's output, as well as how to conduct mining operations, was ready to mine ore the moment that economic conditions warranted restarting the plant. Of course, only a few of the miners were on full time—just enough men to keep things shipshape; but no miner was paying any rent while idle, and many of the men had found temporary employment in a manufacturing town not far away.

The engineer knew—and his principals knew—that the price of the metal produced will finally creep up to that critical figure which will provide a market for the mill's concentrates—or, by research, experimentation, and sheer mining skill a way will be found so to lower the costs as to meet the current market quotations; or a combination of these two will cause the electric siren to screech forth its welcome call to work.

Mining in Georgia—A Barytes Plant Near Cartersville

The barytes washing plant of the Bertha Minerals Co., a subsidiary of the New Jersey Zinc Co., near Cartersville, Georgia

In the steam shovel mine of the Bertha Minerals Co., one of the largest barytes operations in the United States

Mining Camps of North America:

Tonopah, Nevada's Best-known Silver District

Complex Geology an Interesting Feature

By Herman D. Budelman
Mine Superintendent, West End Consolidated Mining Co.

TONOPAH is situated in the southwestern part of Nevada, in Nye County. It can be reached by rail from the north, leaving the main trunk line at Hazen, a distance of 198 miles, or from the south, leaving the main trunk line at Ludlow, a distance of 278 miles. Good automobile roads enter the town from various directions. The population is about 4,000.

The town and mines are situated in a small basin or dilated gulch, on the western slope of the ridge between and about 1,000 ft. above the floors of the Big Smoky and Ralston valleys. The elevation is about 6,100 ft. above sea level. Peaks surrounding the town rise from a few hundred to a thousand feet higher.

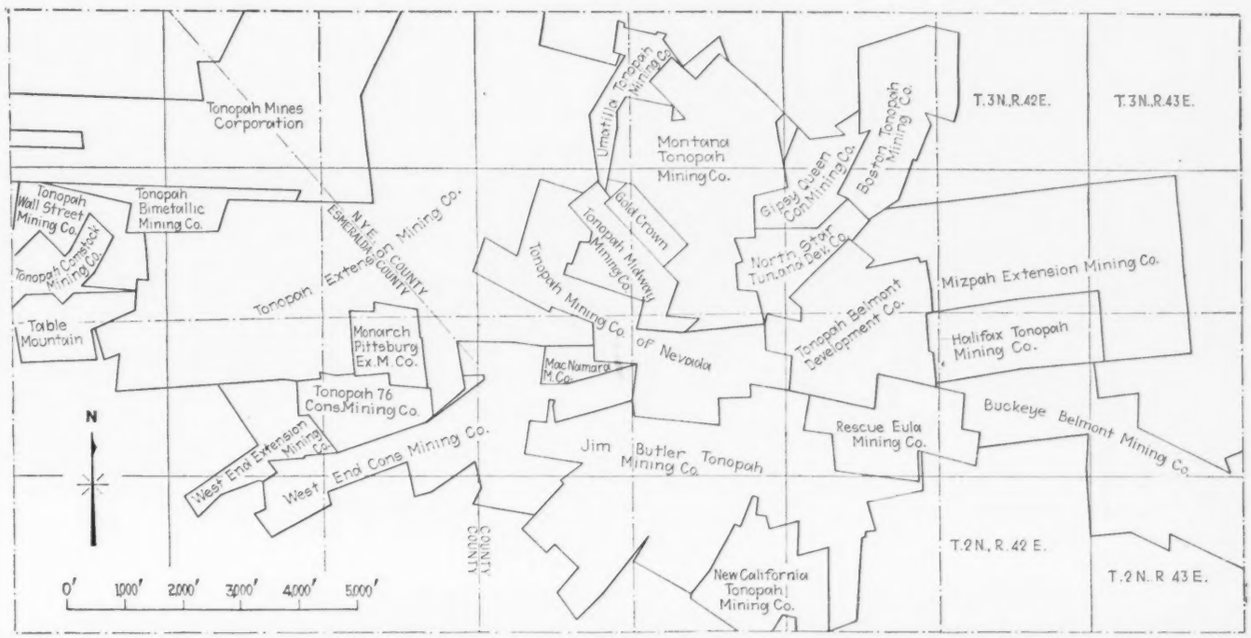
The country is arid, and occasional electrical storms are experienced during the warmer months. Snow, rarely exceeding 6 in. at any one time, falls during the winter months. There is plenty of wind, but winter and summer temperatures are not excessively cold or warm, rarely below zero in winter or above 100 deg. in summer. The chief vegetation in the immediate vicinity is sagebrush, with various varieties of cacti and the usual beautiful desert flowers in the spring. Within a few hours' ride good fishing and hunting can be found.

A plentiful supply of water for all purposes has been developed by drilling at Rye Patch, 14 miles north of Tonopah, from which the water is pumped and piped into town. Several of the mines have encountered water which is suitable for use in the mills. Coal is the principal fuel and is brought in from Utah. Fuel oil from California is used to a lesser extent. Electric power is almost universally used; it is supplied by the Nevada California Power Co. from its generating stations on Bishop Creek, in California, 115 miles distant. The power is transmitted at 55,000 volts, and distributed at 6,600 volts. Lumber and poles are procured from California, Oregon, and Washington.

Tonopah was discovered in April, 1900, by James L. (Jim) Butler, while he was en route from Belmont to prospect the Southern Klondike country, about 10 miles south from Tonopah. He was not familiar with the character of quartz exposed on the outcrops, but was interested enough to take a few chunks along for assay. The Southern Klondike assayer discarded the samples without assaying them, either because he considered them worthless or because it looked like a non-paying job. On a return trip to Belmont, Butler took more samples, and these were handed to Tasker L. Oddie, of Belmont, now United States Senator from Nevada. After some delay assay results were obtained and showed from $50 to $600 per ton in silver and gold. After more delay, Butler, accompanied by his wife, drove out from Belmont, and on April 27, 1900, located what is now the property of the Tonopah Mining Co. of Nevada, and from which more than $15,000,000 in dividends has been paid.

Leases were granted on a 25 per cent royalty, and about $4,000,000 worth of ore was mined before the end of 1901. All leases were verbal and were lived up to, although the grade of ore mined was so high that the owners did not receive a fair share of the profits.

The property was sold in 1901 to the Tonopah Mining Co. Proper equipment was purchased and actual development of an ore reserve started. In 1902 three important discoveries were made outside of the Tonopah Mining Co.'s ground and the boom was on. Claims were located miles from the original discovery, com-


Tonopah Mines Corporation
Tonopah Wall Street Mining Co.
Tonopah Bimetallic Mining Co.
Tonopah Comstock Mining Co.
Table Mountain
Tonopah
N.Y.E. Co. Mining Co.
ESMERALDA COUNTY Extension
Monarch Pittsburg Ex. M. Co.
Tonopah 76 Cons. Mining Co.
West End Extension Mining Co.
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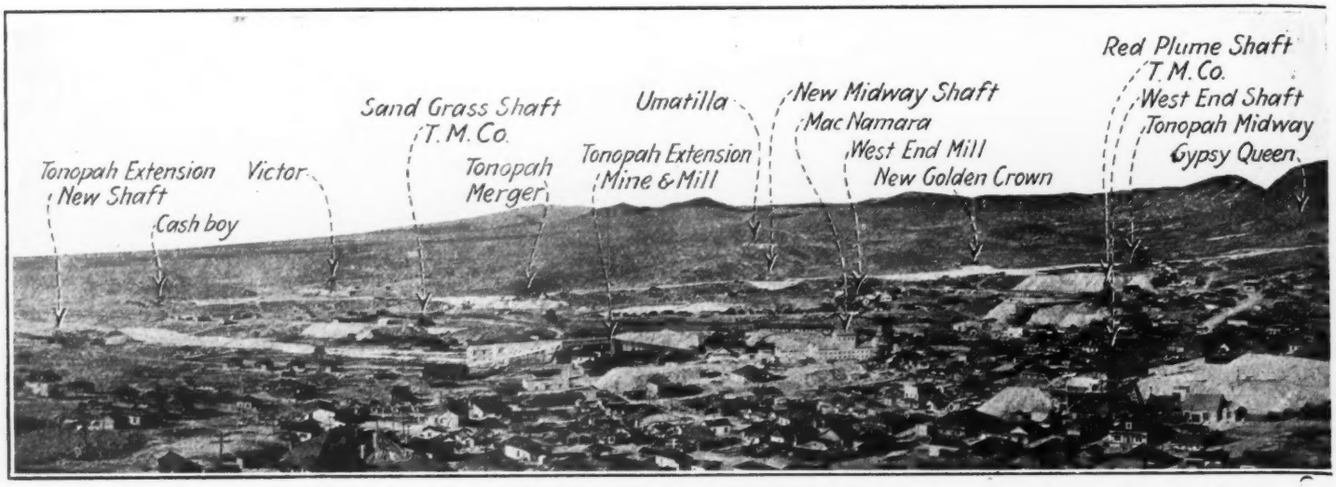
COUNTY
Umatilla Tonopah Mining Co.
Montana Tonopah Mining Co.
Gold Crown Tonopah Midway Mining Co.
Tonopah Mining Co. of Nevada
Mac Namara M. Co.
Jim Butler Tonopah Mining Co.
Gipsy Queen Con. Mining Co.
Boston Tonopah Mining Co.
North Star Tunnel Dev. Co.
Tonopah Belmont Development Co.
Mizpah Extension Mining Co.
Halifax Tonopah Mining Co.
Rescue Eula Mining Co.
Buckeye Belmont Mining Co.
New California Tonopah Mining Co.
T. 3 N., R. 42 E.
T. 3 N., R. 43 E.
T. 2 N., R. 42 E.
T. 2 N. R 43 E.

Map showing ownership of the property in the central portion of Tonopah



This panorama of the Tonopah mining district shows

panies were organized and stock was sold all over the country. Wildcatters were in evidence, their game being helped by the fact that only a very limited area showed vein outcrops, as the ore-bearing formation was covered by later and barren lavas. Several companies struck ore simply by sinking through the caprock and crosscutting, so that any piece of reasonably near-in ground could be regarded as a potential mine. As is usual in a newly discovered boom camp, most of the early work was wasted or incompleted because of lack of or misuse of capital.

Ore shipped previous to July, 1904, when the railroad was completed to Tonopah, had to stand the cost of a 60-mile wagon haul to Sodaville in addition to regular costs, which were necessarily high at this time, and only ore which ran over $100 per ton could be profitably handled. After the entrance of the railroad lower-grade ore could be marketed; but it was not until reduction plants were built at or near the mines that the enormous tonnage of ores valued at under $50 per ton, from which has come the real production of the district, could be handled at a profit.

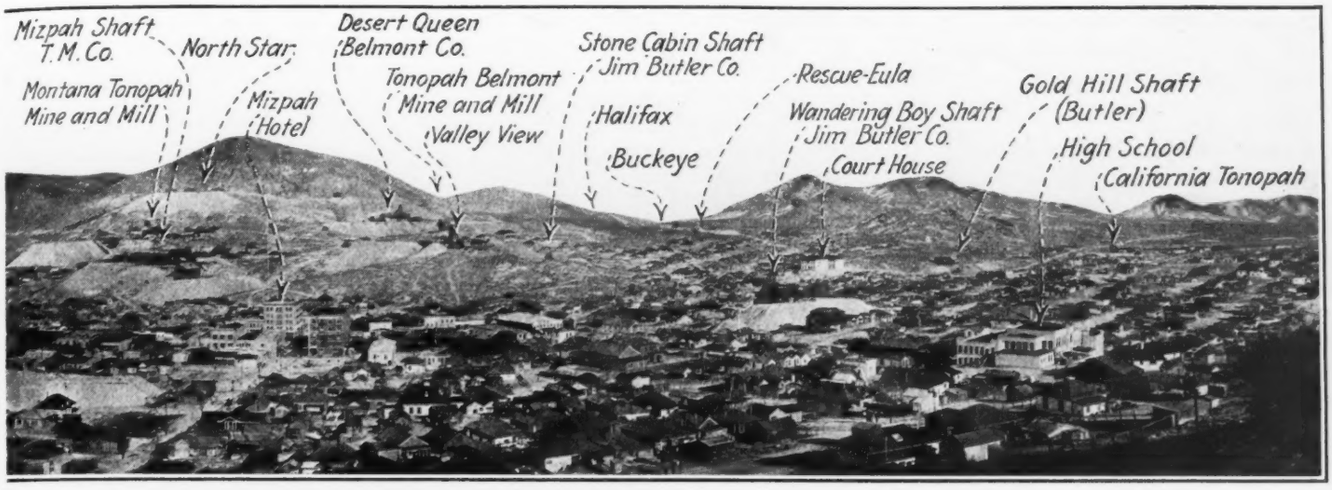
As in most mining camps, mine conditions varied from good to bad, resulting in alternating periods of optimism and depression. However, for the eighteen years from 1905 to 1922 inclusive, the average yearly production was valued at about $7,000,000. Peak production was reached in 1912, 1913, and 1914. In 1913, 574,542 tons of ore was mined, which contained 126,444 oz. of gold and 11,563,437 oz. of silver, having a total value of $9,598,733. Production in 1922 was 415,000 tons, with a gross value of about $7,000,000; that of 1923 was valued at slightly in excess of $5,000,000, the decrease being due principally to the drop in price of silver after completion of the Pittman Act purchases in the middle of the year. The total production of the district to the end of 1922, according to figures compiled by Victor C. Heikes, is 6,734,283 tons of ore, which contained 1,530,442 oz. of gold and 144,568,026 oz. of silver, with a gross value of $127,636,903. The average metal content of the ore was 0.227 oz. of gold and 21.47 oz. of silver per ton. The actual average value was $18.95 per ton, this figure being based on receipts from sale of bullion, the silver content of which had a fluctuating value.

After a thorough study by J. E. Spurr, the U. S. Geological Survey published Professional Paper No. 42 in 1905 descriptive of the "Geology of the Tonopah Mining District." Later examinations by Mr. Spurr resulted in some changes of conclusions, and these were incorporated in his article entitled "Geology and Ore Deposition at Tonopah, Nevada," published in the December, 1915, issue of *Economic Geology*. Except for differences of opinion on unsettleable points and minor changes and additions due to later developments, Spurr's geology is generally accepted and relied on. It is of great service to operating geologists, and is a shining example of real aid on the part of the Geological Survey to the miner and the industry.

The rocks of the district are of the Tertiary period, are all of volcanic origin, and consist of trachytes, andesites, dacites, breccias, and rhyolites. These occur as flows and intrusions, resulting in complex geological conditions which offer intricate problems from an operating standpoint. The rocks most important as ore containers are the Mizpah trachyte, West End rhyolite, Extension breccia, and Montana breccia.

The Mizpah trachyte, which is the oldest rock in the district, has so far proved to contain the richest average ore and by far the largest tonnage. It is the only container of commercial orebodies in Tonopah which outcrops on the surface, the actual outcrop area being not over one-tenth of one square mile, the rest of this formation being covered by later cap rocks up to several hundred feet in thickness. The body of Mizpah trachyte so far developed has a maximum extent of two miles easterly and westerly, less than one mile northerly and southerly, with a maximum thickness of about 600 ft. There appears to be a decided tendency toward domal shape, with the top of the dome the outcrop area; and, generally speaking, a thinning of the trachyte body in all directions from the dome top. The actual termination of the trachyte is in many instances on faults, so that future developments may prove a continuation in almost any direction. It is a porphyritic rock, very much altered and silicified, and there has been some disposition to call it an andesite rather than a trachyte, the chemical analysis being used as a deciding factor in favor of the latter.

The West End rhyolite contains some important orebodies, with the average grade of ore much lower than in the trachyte. When it forms one wall of a vein, its importance is most evident. The rhyolite lies below the trachyte, and is sometimes intrustive into it, and its



nearly all of the developed portion of the camp

proven lateral extent is greater than that of the trachyte, especially in the western part of the district. Its thickness is very erratic; it varies up to several hundred feet, but becomes more regular to the west. It is a greenish rock with finely crystalline groundmass, highly siliceous, and containing numerous light-colored and much altered inclusions up to several feet in diameter.

The Extension breccia is a relatively new formation in the district, and occurs extensively in the western and northwestern part of the developed area, where its lateral and bottom limits have not as yet been determined. Important orebodies are found on the contact between West End rhyolite and Extension breccia and within the Extension breccia itself. The average grade of ore is not so high as in trachyte veins, but the orebodies are sometimes very large and profitable. It is a well-defined breccia, quite siliceous, and shows quartz phenocrysts. It is grayish to light brown and contains highly altered fragments of various kinds of rock.

The Montana breccia occurs extensively throughout the district, usually in the vicinity of the West End rhyolite on either the upper or lower contact. Its volume is probably much less than that of the West End rhyolite or the Extension breccia. Some small commercial orebodies have been found in this breccia, but results of development to date would not indicate that it will ever prove to be an important container of ore. It is a decided breccia, quite siliceous, the inclusions and fragments of different rocks in some instances almost obliterating the groundmass. It is at times difficult to differentiate between the Montana breccia and the Extension breccia, and the latter is easily confused with other breccias occurring in the district. It is possible that later developments and detail study of the different breccias may prove their close relationship.

Other rocks in the district are andesites, rhyolites, dacites, and breccias. They occur as flows and intrusions, and their importance lies in the fact that they cover, underlie, or terminate laterally the ore-bearing formations and veins, and their occurrence and identity must therefore be studied in order to prospect intelligently for new veins or the continuation of old ones.

There are numerous faults throughout the district, many very large and unsolved as yet. Aside from the fissures in which the veins were formed, most of the faults were probably post-mineral and occurred at different intervals during or following periods of volcanic activity. In some cases these faults are mineralized and contain valuable ore. As a rule the faults are normal, although reverse faults are not uncommon.

There are probably more than fifty veins in the district which have produced or are producing. Most of them are clearly of fissure type, with both hanging and footwall branches, which often separate and reunite. Widths are not uniform, varying from a few inches to more than 50 ft. of ore. In some occurrences there are well-defined walls; in others the walls are imaginary only and represent the dividing line between pay and non-pay material. The veins are fairly continuous on their strike and dip until interrupted by faults or later intrusions. Rich stopes have been terminated in this manner, indicating the possibility of rich ore of like grade below or beyond the interruption.

The general strike of the veins is easterly and westerly, although deviation of 45 deg. to the northwest or southwest is not uncommon, especially in the western part of the district; and the dip may be either to the north or south, although a north dip is more usual.

Vein filling consists mainly of quartz with manganese, almost invariably present as the oxide, carbonate, or silicate. Valuable minerals are silver and gold, the ratio of silver to gold being almost exactly and uniformly 100 to 1 by weight. The silver occurs mainly as sulphides of various kinds, with occasionally chlorides and iodides, and as native silver.

In the central and eastern part of the district the veins are mostly in Mizpah trachyte; they have a strike slightly north of east and an average steep dip to the north, and sometimes to the south. It is this territory which is accountable for the major part of Tonopah's production of $130,000,000 in silver and gold. Some of the rich veins were stoped almost continuously for several thousand feet along the strike, with of course many large and small fault interruptions, until terminated on the east against a rhyolite intrusion and an east-dipping fault of unknown magnitude in the Halifax Tonopah ground. On the dip the veins are terminated by barren formations at depths varying from 600 to 1,400 ft. below the surface. This territory has been well prospected along the line of the known veins, and these veins are virtually exhausted within the above-named limits.

In the west-central and western areas of the district

Victor headframe and surface buildings

This shaft belonging to the Tonopah Extension company is the deepest in the district, the lowest level being the 2,000, and is now being sunk to the 2,250 level as a temporary objective. Probably the largest body of ore ever exposed on one level in the Tonopah district is now opened up on the 2,000 level from this shaft. This orebody is more than 600 ft. long and reaches a maximum width of 110 ft. Values are holding well.

conditions are somewhat different from those in the central and eastern parts. The westerly extensions of the trachyte veins have been nearly worked out, and most of the present production of the camp is coming from lower grade but large and profitable veins which have various inclosing rocks. There are veins with Mizpah trachyte on both walls, with Mizpah trachyte on one wall and West End rhyolite on the other, with West End rhyolite on both walls, with West End rhyolite on one wall and Extension breccia on the other, and with Extension breccia on both walls. Sometimes the vein fissure passes from one formation to a contact, follows the contact for some distance, then passes to another formation, with oreshoots in all horizons. The strike of these veins varies from northeast to southeast, with local strikes nearly north and south, and the dip varies from steep to flat, either to north or south. As already stated, the average grade of ore in these veins is much lower than in the trachyte veins, but the shoots are sometimes very large and rich and are quite profitable. The veins are broken and interrupted by faults and intrusions, and their extent westerly and downward has not yet been fully determined. The Tonopah Extension has, in the extreme northwesterly part of the developed area of the district, followed one of the largest oreshoots ever developed in Tonopah to the 2,000 level, where values and width compare favorably with showings on upper levels.

In addition to the various veins described there are many others of comparatively recent age which, so far as developed, do not carry pay ore. These are not of special interest at present, but may become so.

The present scale of operations in Tonopah is about 40 per cent below that which existed up to June, 1923, at which time silver purchases under the Pittman Act were completed, and the price received for silver dropped from $1 to 65c. per ounce. In instances the margin of profit was wiped out on a large proportion of the production, and the only course was to do selective mining and reduce tonnage. The Tonopah Belmont closed its 500-ton mill and shipped its ore to the Millers plant of the Tonopah Mining Co. To date none of the dividend-paying mines has been forced to close down, but without new developments or a rise in the price of silver their probable life is problematical.

The principal operating companies are the Tonopah Extension Mining Co., of which John G. Kirchen is general manager, John L. Dynan mine superintendent, and E. M. Kirchen mill superintendent; the West End Consolidated Mining Co., of which John W. Sherwin is general manager, H. D. Budelman mine superintendent, and F. C. Ninnis mill superintendent; the Tonopah Mining Co. of Nevada, of which W. H. Blackburn is general superintendent and consulting engineer, and H. A. Johnson superintendent of mine and mill; and the Tonopah Belmont Development Co., of which L. R. Robins is superintendent. Other smaller companies are the Halifax Tonopah, Rescue Eula, Montana Tonopah, North Star Tunnel & Development, Jim Butler Tonopah, McNamara, Tonopah Midway, Monarch Pittsburgh, and Tonopah "76."

Following the completion of silver purchases under the Pittman Act, the total tonnage for the district dropped from about 1,400 to 850 tons per day, and the value of bullion shipped from about $600,000 to $300,000 per month, but production has since improved.

The Tonopah Extension was the only large shipper to continue without diminishing tonnage below its mill capacity after the drop in the price of silver. This company is mining ore at a depth of 2,000 ft., which is the deepest working in the district. Development work is being pushed, especially in the western part of the district, and new discoveries or developments can be expected at any time.

All of the main shafts are vertical, with levels about 100 ft. apart in productive territory. The orebodies are developed by drifting, raising, and sometimes winzing before stoping is started.

The method of ore extraction varies with conditions. The veins of the district may be flat, vertical or at almost any angle; they vary from less than a foot to more than 50 ft. in width. The wall rock is usually fairly strong and can be supported by timbers until back-filled before opening too large a territory. But in some localities the ground is exceedingly heavy and requires careful mining. Where conditions warrant, shrinkage stoping is done, but all stopes are carefully timbered to prevent dilution of the ore. Narrow stopes are stulled, and wide stopes are square-setted. The flatter veins are worked by footwall crosscuts and

raises, the spacing of the raises being an economic problem depending on width of vein and other factors, but they are seldom closer than 50 ft.

The ore usually is hard, sometimes exceedingly so; all requires blasting. The tonnage broken per machine round depends on stope conditions, and may vary from five to more than fifty tons, with an average of probably around fifteen.

Most of the short tramming is by hand; but trolley and storage-battery locomotives have practically displaced hand tramming or mule haulage on long main haulageways. Most of the mines use shaft pockets, loading directly into skips, although at some shafts cars are still hoisted and trammed to surface bins. Practically all sorting is done underground, and the waste from both stoping and development is used as stope filling. From the mine surface bins the ore is conveyed by belt, railroad cars, trolley or gasoline truck to the mill bins, depending on the location of the mill with reference to the working shafts.

On account of the involved geological conditions it is necessary to do considerable development work. Much of this work consists of crosscuts, prospecting ground outside the known ore zone, and searching for faulted segments of veins or new veins. The later intrusions and the faulting make this work very interesting and uncertain, and it must be closely watched, as experience has proved that there are ever-present possibilities for important developments.

The total mill capacity in the Tonopah district amounts to 2,220 tons per day, but this quantity never has been milled at any one time, 1,600 tons per day being the probable maximum. Following is a list of the milling plants, some of which have either been dismantled or are idle: Tonopah Mining, Millers plant, situated at Millers, 14 miles from Tonopah, where it was constructed previous to the provision of an adequate supply of water nearer the mine, with a capacity of 500 tons per day; Tonopah Belmont, Millers plant, capacity 300 tons per day, now practically dismantled; Tonopah Belmont, Tonopah plant, not in operation since July, 1923, capacity 500 tons per day; Montana Tonopah, not in operation, capacity 150 tons per day; West End, capacity 265 tons per day; Tonopah Extension, capacity 425 tons per day; and McNamara, not in operation, capacity 80 tons per day.

In the early days of the camp amalgamation was tried in what is now a part of the remodeled and enlarged West End mill, but on account of the character of the ore the attempt was not successful. This mill was later changed to a sand-leaching and slime-agitation plant, and later to an all-slime plant.

The Tonopah Mining Co. constructed its 100-stamp mill and cyanide plant at Millers in 1906. It was originally designed and built as a sand-leaching and slime-agitation plant, but was later changed to an all-slime plant. It was successful from the start, and all other mills in the district are, in a way, similar to it.

It is important to note the fact that no cyanide plant ever constructed in Tonopah failed of its purpose. In fact, metallurgists of the camp have pretty well standardized the practice of milling Tonopah ores.

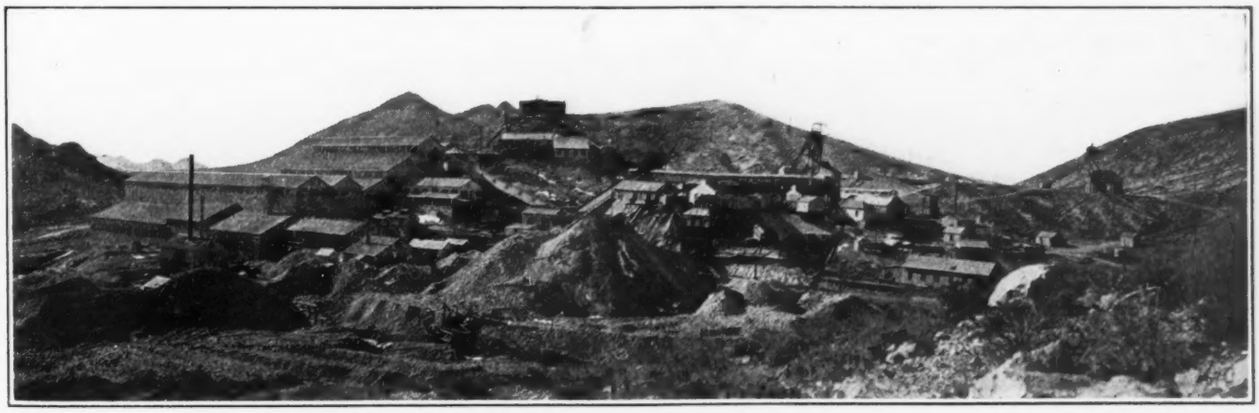
The following is a necessarily short description of standard milling practice in Tonopah: Primary crushing is done in jaw or gyratory crushers, the run-of-mine ore being crushed to 1½ in. The ore is then delivered to the mill bins and fed through Challenge feeders to stamp batteries, crushing in cyanide solution to from 3 to 6 mesh. No rolls are used for crushing in any of the mills, although there is evidence, by actual trial at the Tonopah Mining Co.'s mill, to indicate that rolls could be successfully used on Tonopah ores. The battery product is classified in Dorr classifiers, the oversize being fed to tube mills, standard size about 5 by 18 ft., using Danish pebbles, and grinding to 75 per cent through 200 mesh. The overflow passes to Dorr thickeners, then to agitators, of which various types are used. Agitation is continued for sixty hours at a temperature of 115 deg. F. Cyanide is usually added at No. 1 agitator. The pulp from the agitators passes to Dorr thickeners, then to a Butler type filter, after which the tailing is discharged.

Precipitation on zinc shavings and precipitation by zinc dust have both proved successful, although the former has been more generally used. Since the closing of the Tonopah Belmont 500-ton plant, all operating plants use the zinc shaving method of precipitation.

The precipitate is melted in Monarch-Rockwell furnaces, carborundum lined, and the bullion is molded in approximately 2,000 oz. bars. The average fineness of the bullion is about 10 gold and 950 silver. The bars go to the Selby smelter or the U. S. Mint for refining.

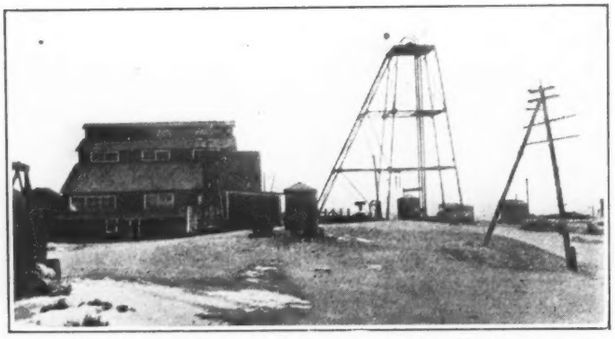
No concentration is used by any of the present operating plants, although the Tonopah Belmont did concentrate after tube mills up to the time that its mill closed in July, 1923. The average extraction is about 94 per cent of the gold and 92 per cent of the silver; this is about 93 per cent of the contained value.

It is difficult to give any but general figures as to operating costs, as the different companies have dif-



Tonopah Belmont surface plant

This shaft is 1,700 ft. deep, but practically all production has come from above the 1,400 level. The mill has a daily capacity of more than 500 tons, but is now idle.



Mizpah headframe of the Tonopah Mining Co.

This shaft was sunk on Mizpah hill, where the only trachyte outcrop of the district is found, and it is likely that more value has been hoisted through this shaft than through any other in the district.

ferent methods of keeping cost accounts. In addition, costs vary in the different mines, depending on whether the veins are wide or narrow, flat or steep; upon the amount of sorting necessary, the character of the wall rock, and the scale of operations. Mill costs are affected by the size of plant and by efficiency of operation.

Average mine costs for the district are between $5 and $6 per ton, probably nearer the former figure. This includes a charge of approximately $1 per ton for development expense. Average mill costs are between $3 and $3.50 per ton. On the present scale of operations there would probably be no profit on ore of a gross value of less than $9 per ton, and it is doubtful if ore of a gross value of less than $7.50 per ton was ever mined and milled at a profit in Tonopah.

Tonopah has always paid high wages, and in consequence has usually had a good and sufficient supply of skilled and unskilled labor. Until August, 1919, the camp has been singularly free from serious industrial disputes, but in that year, owing to a combination of circumstances—chief among which were war conditions, scarcity of labor, and the Divide mining boom, only five miles from Tonopah—a small group of "radicals" engineered a general strike. Soap-box methods were used, and extreme demands were made. The result was that the men lost about $700,000 in wages and the companies were closed down for three months and operated at reduced capacity for several months longer. Much animosity was engendered between employer and employee, as well as among the employees themselves, and this feeling was indirectly responsible for the later but less disastrous labor disturbances of 1920 and 1921. During 1922 and 1923 conditions were stable.

The present scale of wages per shift is, for miners and timbermen, $5.75; muckers and helpers, $5.25; hoist engineers and blacksmiths, $6; surface labor, $5; mill men, $5 to $6; and machinists, $6 to $6.50.

Living conditions in the camp are above the average and living costs are comparatively low, the latter being due partly to the installation by the mining companies in 1920 of an up-to-date store or commissary which distributes foodstuffs practically at cost.

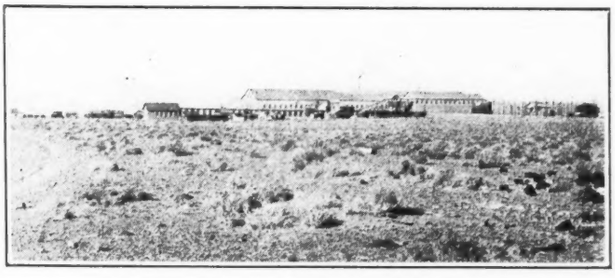
Most of the developed area in the Tonopah district has been thoroughly prospected and by far the greater part of the ore removed, although many important but relatively small orebodies will undoubtedly yet be found in this zone. The future of Tonopah lies in discoveries or developments outside this proved zone. There are possibilities for the discovery of a downward or easterly extension of veins which have been terminated on dip or strike by faults or intrusions; for the discovery of new veins to the north or south of the proved area, and their development on strike and dip; for the discovery of commercial oreshoots in known veins which, so far as developed, are regarded as unproductive; and for important developments to the west, and downward on veins which have not yet been terminated, as well as the discovery of new veins to the west.

Possibilities appear remote for the discovery of the downward continuation of the terminated veins. The thickness of the underlying formation is unknown, except that in the central part of the district it has been proved by diamond drilling, to have a minimum thickness of more than 1,000 ft. Though this drilling may have been done in a volcanic neck and have no bearing on conditions outside a limited area, it appears probable that to prospect for these downward continuations deep mining will have to be resorted to, with its higher costs.

It is possible that the easterly extension of the veins terminated on their strike may be found. Little work has been done east of the east-dipping fault previously mentioned as passing through the Halifax Tonopah ground, but what has been done indicates it to be a large and normal fault. So far as I know no information is available from which either the lateral or vertical displacement can be estimated. New veins may be found to the north and south of the proved zone, but development work to date indicates a necessity for deep prospecting to locate ore-bearing formations.

There are known veins which have been but little prospected, which are regarded as relatively later veins, but which may prove to contain oreshoots in certain horizons. These veins are not regarded as important, and little work is being done in them. However, if commercial ore should be found in one of these low-grade veins, they will be extensively prospected.

Conditions in the western part of the district appear favorable. As previously stated, the Tonopah Extension has followed a large vein to the 2,000 level, at which elevation the oreshoots are as large as or larger than on upper levels, and just as rich. The West End recently encountered and is now developing a vein which contains ore in the Tonopah "76" ground. This showing is only 600 ft. below the surface and may extend upward several hundred feet. Neither the westerly nor downward continuation of these showings has been determined. It does not appear that any unsolvable faults have been encountered in this western part of the district, although it is apparent that erosion has robbed this territory of most of its trachyte, and hence of its trachyte veins. However, other important ore-bearing formations have been found in this western country, and showings indicate reserve possibilities. Much work will undoubtedly be accomplished in the western area of the Tonopah district during the next few years, and the chances for successful development appear to be good.



Desert mill of the Tonopah Mining Co.

Situated at Millers, 14 miles from Tonopah, this is the pioneer mill for the Tonopah district. Its capacity is 500 tons per day.

A Basis for Selecting Flotation Agents

Observations in Practice Indicate That Their Colloidal Condition and Electrostatic Charges Have Important Bearing on Results—Two Classes of Compounds Afford Ample Choice

By H. E. Fredrick
Flotation Engineer, San Diego, Calif.

THOUGH THE FLOTATION PROCESS has now been in commercial use for more than a decade, the theory of its action has not yet been convincingly explained. Some of the underlying principles have been pointed out, but no all-embracing explanation of the various phenomena, in usable form for the practical operator, has so far been promulgated.

In looking back over seven years' work, certain observations impress me as worth recording, in the hope that some one with the requisite knowledge of physics may find them helpful in the further development of a workable theory. In fact, I may even suggest a few theories of my own, with the full knowledge, however, that I have not sufficient experimental data at hand to prove them.

Importance of the Function of Mineral Salts

Modifications of the surface tension of water do not seem to me to play so large a part in flotation as is generally thought; that is, the contaminant is not responsible for the lowering of the surface tension to the extent of forming permanent bubbles. As a proof of this, a well-washed ore used in a pure distilled-water circuit will not form mineralized bubbles with the usual flotation agent, with oil which gives good results under mill conditions, or with the usual tap waters. The addition of almost any mineral salt that forms a true solution in the circuit water determines the frothing and selective value of the reagent.

Preferential affinity of oil for mineral over gangue plays no direct selective action in froth flotation. All successful flotation oils are mainly mixtures of hydrocarbons and derivatives, the hydrocarbons being mostly neutral in the sense that they do not react with either dilute acids or alkalies. In addition to the neutral hydrocarbons, flotation oils contain certain compounds that are more or less soluble in water and have either a distinct acid or basic reaction. This is true of all the oils, but the more soluble ones are, in order, pine oils, pine tars, hardwood creosotes, coal-tar oils, and petroleum oils.

If any of these oils is treated repeatedly with a dilute solution of caustic soda until no further loss of weight occurs, followed by repeated washings with dilute hydrochloric acid, the washed oil residue will have no ability to froth or gather mineral. The steam-distilled pine oils usually have an acid reaction, and but little is left of them after the caustic soda treatment. If the oil has a high boiling point it may be necessary to use heat to make a complete extraction.

Flotation Reagents Either Acidic or Basic

Most destructively distilled hardwood and coal-tar oils contain both acid and basic water-soluble compounds. The acid portions are usually of the hydroxy (OH) type, whereas the basic compounds usually contain nitrogen either in the ring (heterocyclic) or side chains. Nitrogen is not, however, absolutely necessary to establish the basicity of the reagent. In general, the non-neutral compounds are the active selective and frothing agents. Frothing and selective qualities are never found in neutral hydrocarbons. In other words, a good mineralized froth can be obtained under proper conditions with either an acidic or basic reagent, or a mixture of the two, but never with an insoluble neutral hydrocarbon.

Certain reagents belonging to the amido group of benzene hydrocarbons have come into successful use: amido derivatives of xylene, napthalene, and toluene. The formulas of these are simple, all having an NH_2 group which makes them behave like an alkali, and making them basic reagents. They are the simplest synthetic substitutes that can be prepared to match the results obtained by the natural bases present in the usual wood and coal-tar oils, which belong more or less to the N-membered heterocyclic (or pyridine) series of compounds. One example of amido compounds in general use is X-cake (alphanapthylamine). The use of this compound is made more efficient by the use of lime or other mineral alkali. On the other hand, cresylic acid, and other acids of the aromatic hydroxy type, are generally used with success when sulphuric acid is added, or with naturally acid ores, or an acid mill circuit.

Now, the point I wish to bring out is that acid pulps have been successfully treated with cresylic acid or oils containing a relatively high percentage of tar acids (such as Barrett No. 4), whereas with a basic circuit, better results are usually secured by using an oil containing basic compounds or by the use of one of the amido compounds mentioned above. The commercial success of Barrett No. 4 oil may be attributed to the fact that this oil contains both acidic and basic hydrocarbons.

Flotation Agent Present in Colloidal Form?

Another thing to note regarding the solubility of a successful reagent: the acid compounds are not so soluble in dilute acid as they are in neutral water; and basic compounds are likewise less soluble in alkaline water than in pure. As a matter of fact, under proper conditions, I do not think that the selective agent is in true solution in the pulp in which it is active, but, rather, exists in a colloidal state.[1] A number of substances can assume a state of colloidal subdivision in the pulp without showing a selective action, but they are neutral hydrocarbons. Substances like glue and saponin are neutral substances which cannot form the active colloidal subdivision, and are effective only as frothing agents.

Evidently, there are hundreds of thousands of pos-

[1]An experienced flotation worker has told us that he believes the more powerful selective reagents do form true solutions in water, though they are extremely dilute solutions. These solutions, when added to an ore pulp, are effective in flotation. Sometimes their effect appears to be due to adsorption from solution on the surfaces of the floatable particles, and he believes this to be the explanation of the selective, or collecting, action.—Editor.

sible reagents, but we can restrict ourselves to those of the benzene series which are known to be chemically suitable, and which include more than sufficient classes of compounds. As already stated, the suitable ones are restricted to those which are non-neutral and capable of going into a state of subdivision which develops colloidal properties.

Every minute active colloidal particle of a flotation reagent I assume to have a definite electrostatic charge. This would partially explain why a neutral hydrocarbon cannot show a definite attraction for mineral over gangue, and also why an excess of reagent does not exert a selective action, but brings up gangue as well.

Now, based on the above presumptions, certain ideas have occurred to me, which may be worth reporting. Let me assume for the present that the usual sulphide minerals have either an electrostatic charge or are capable of becoming charged under the usual method of aëration or agitation. The natural result of surface tension is to concentrate the colloids of the flotation oil on the surface of the liquid medium. The introduction of air or gas, by any means, creates additional surface area which surrounds the displaced liquid, or pulp. The colloids, by virtue of the surface tension of the liquid, are attracted to this new surface, on which they attach themselves like the figures on the wallpaper of a room. These particles, let me assume, have a charge of electricity opposite to that of the mineral, the gangue being electrostatically neutral. This colloidal film attracts, or, what is more reasonable, holds the particle of mineral brought into contact with it as the bubble rises, and allows the gangue particles, together with any other mineral particles having the same charge, to slide off the bubble film. If any dielectric is required it could probably be supplied by either the adsorbed gas on the mineral particles, or the accidental presence of oil, or purposely added oil.

In certain tests that I have made I have taken great pains to eliminate every trace of oil from the ore, water, and reagents, and also any lubricating oil from the machine. The phenomena were the same, except that in the absence of all oil, although the mineral was carried to the surface, it did not form a persistent froth; in fact, all chemically pure reagents make a characteristic effervescent froth, the bubbles of which break rapidly, transferring their load to their neighbors.

That the reagent is concentrated in the bubbles may be easily and effectively proved. Use a pure soluble reagent such as U. S. P. cresylic acid, c. p. alphanapthylamine, or c. p. pyridine, in a small laboratory flotation machine. This can be used either with tap water alone, or water and powdered ore. In general, 10 per cent of the water recovered from the froth will contain as much as 90 per cent of the reagent added.

Another thing which indicates the importance of the electrostatic charges in flotation is the results obtained in preferential separation of various minerals. Using simply a basic reagent with alkali for one mineral, followed by an acidification of the circuit with cresylic acid, for another, or vice versa, I have obtained good separations of chalcopyrite and pyrite; chalcopyrite, chalcocite, and pyrite; galena and chalcoyprite; and zinc blende and chalcopyrite, rejecting pyrite. I believe the secret of controllable preferential flotation will be found to lie in this direction, together with fine grinding and proper classification.

A small proportion of oil added to any of the so-called soluble reagents in most instances improves results. However, this added oil is mainly beneficial because the flotation machines are designed for the use of oil; if the action of "soluble" reagents were taken into consideration in the design of the machines, it is quite possible that oil-less reagents would be far more efficient. Of course, the oil stabilizes the bubble, and bubbles certainly need stabilization to travel the uncertain paths which they follow in nearly all flotation machines.

I have found that alkali sulphides do not act in practice as sulphurizing agents, but merely modify the selectivity of the flotation agent used. This is explainable by the colloidal theory outlined above, inasmuch as the presence of the alkali sulphide influences the electrostatic charges. To be excepted, of course, is the case when the metal is actually brought into solution and then precipitated by the sulphide.

A comparatively new idea in reagents is thiocarbanalide. This contains sulphur and is an improvement on the old idea of distilling pine oils with sulphur. As with the alkali sulphides, I think the action is more physical than chemical. Compounds of this kind have possibilities; why does not some one try the mercaptans with selective reagents on ores which require sulphurizing?

The theories that I have suggested may not be generally accepted, but an observance of them will help in picking out a suitable reagent and a suitable chemical condition of the pulp for a given ore, for any unaltered ore that lends itself to flotation can be floated either with one or a mixture of the aromatic hydroxy compounds, preferably in an acid circuit, or with one or a mixture of either the benzene amido, or nitrogen heterocyclic compounds in alkaline circuit. Furthermore, if there is but one mineral to be floated from an ore, a mixture of both the acids and bases will do it. If either the acidic or basic substances, or a mixture of the two, is ineffective, no other oils or reagents will give good results unless the ore be modified by sulphurizing or other treatment.

In both classes of these compounds, starting with the lowest member of each series, as the boiling point and molecular weight increases, smaller quantities of the reagent are required. Sometimes, with very fine slime, the reagents with the lower boiling points give the best results. Every derivative of either class of compounds, or mixtures of them, can be used as flotation reagents. One can be named for each man, woman, and child in the United States and still we can have enough left for future generations.

Slag Composition Studied by G. Rigg

The chemical and petrological examination of cooled slag does not interpret the condition of the slag in the molten condition in the furnace, and the effect of dissolved carbon monoxide on the presence of metallic oxides in slags and on the viscosity may be important, according to G. Rigg in a paper on blast-furnace slags recently published by the Faraday Society and reprinted in *Chemistry & Industry*. The percentage composition of a slag from zinc furnaces at Port Pirie (South Australia) was SiO_2, 20.1 per cent; Fe_2O_3, 28.2; MnO, 3.9; CaO, 11.0; MgO, 2; Al_2O_3, 6.2; ZnO, 22.1; S, 2.7 per cent. Slags containing 20 to 30 per cent ZnO flow freely provided sulphur is present in only small quantity, but if the sulphur content is too high, zinc sulphide soluble in the slag in the furnace separates out around the tap-hole and on cooling after running from the furnace.

Consumption of the Platinum Metals

They May Be Used Interchangeably in Various Industries

By Jas. Lewis Howe
Washington and Lee University, Lexington, Va.

Jas. Lewis Howe

THOSE who have for a considerable number of years been viewing with concern the increasing consumption of platinum in jewelry cannot fail to have their apprehensions deepened by the report of the U. S. Geological Survey, just made public, on the production of platinum and the allied metals for 1923. Bad as is the state regarding platinum, the iridium situation is even more disquieting to all interested in the metal.

The total consumption of platinum for 1923 is placed at 152,376 troy ounces, distributed as follows:

Platinum Consumption in 1921, 1922, and 1923

In Troy Ounces

	1921	1922	1923
Jewelry industries	101,258	108,527	105,699
Electrical industries	20,574	24,988	18,596
Dental industries	13,181	11,651	16,288
Chemical industries	12,273	8,834	8,637
Miscellaneous industries	3,791	2,838	3,156
Totals	151,077	156,838	152,376

This represents no considerable change in consumption in the last three years, though there seems to be a trend toward increased consumption in the jewelry industries and decreased consumption in the chemical industries. In terms of percentages the amount of platinum used in jewelry in 1923 was 69.37 per cent and in 1921 67.02 per cent of all platinum used. The corresponding figures for iridium in jewelry are 47.17 per cent for 1923, against 31.91 per cent in 1921.

Home Production Small

As sources of platinum we have a domestic production for 1923 of 609 oz. of crude platinum, 578 oz. of which were recovered in California, 24 oz. in Oregon, and 6 oz. in Alaska. This is a material reduction from 1922. In this latter year 53,385 oz. of crude platinum were purchased from Colombia, 10,085 oz. from Russia, and 12 oz. from Canada. The detailed figures for 1923 are not available, but the imports were slightly less than in 1922. In addition to this, "secondary" platinum to the amount of 40,062 oz. was recovered, mostly from scrap and old material, but much of this scrap may have been worked over several times during the year; this 40,000 oz. is far from representing any such addition to the platinum supply. The secondary platinum for 1923 was approximately the same as for 1922.

Before the war by far the largest source of platinum (85 per cent to 90 per cent) was Russia, but certainly no large amount is being produced there at the present time, and it is doubtful if Russia can be counted on for any dependable supply in the near future. It was currently reported about a year ago that Professor Duparc, of Geneva, the only important authority on the Russian platinum deposits, had been employed by the Soviet government to rehabilitate the Ural workings, but nothing has since been noted regarding the matter.

During the war great efforts were made to provide substitutes for platinum. My bibliography of platinum contains not fewer than one hundred and fifty entries regarding substitutes from 1914 to 1922. The use of platinum has been greatly restricted; the amount absolutely needful for individual purposes has been cut down to the lowest limits, and its use in jewelry has constantly increased.

Uses of Palladium

Taking up for consideration the other metals of the platinum group, the recovery of new palladium in 1923 was 1,934 oz., and of secondary palladium 6,246 oz.—together 8,180 oz. This is a little larger than the figures for 1921, 7,573 oz., and a little above the average for the last six years, which was 7,064 oz. On the other hand, the consumption of palladium in 1923 was 30,201 oz., about 11,000 oz. more than in the preceding year. This discrepancy between consumption and production, even when the imports of the year are added, is possibly accounted for by the use of remainders of stocks, said to have been accumulated near the close of the war for alloys to replace platinum for certain purposes. Comparing the uses to which palladium has been put in the last three years, we find the following:

Consumption of Palladium, 1921, 1922, and 1923 by Industries

In Troy Ounces

	1921	1922	1923
Jewelry industries	1,265	9,852	14,948
Electrical industries	7,626	2,735	3,666
Dental industries	8,501	5,535	10,116
Chemical industries	45	458	485
Miscellaneous industries	217	636	986

Palladium is of restricted use in the chemical industry and comparatively little is required in the electrical industries. The fact that gold can be alloyed with palladium to give a metal which can replace platinum for certain purposes, including utensils in the chemical laboratory, furnishes a fairly steady demand for the supply, which, though limited in amount, is perhaps steadier than that of the other metals of the platinum group. As will be seen from the accompanying table, there is a rapid increase in the amount of palladium used in jewelry, one-half of that used in 1923 being in this industry; indeed, the amount used was nearly twice as large as that recovered by the refiners. The increasing amount of palladium used in jewelry may be viewed by the chemist without apprehension, as it is hardly as yet one of the, to him, indispensable metals, though it may be doubted if the supply of palladium will stand any largely increased demand. However, it should be added that the great cost of the metal is the only thing which precludes its use on a large scale industrially as a catalyst.

The new iridium recovered by the refiners in 1923 was 280 oz., a steady decline from 1918, when the amount was 465 oz. The secondary recovery was 2,021

oz., against 3,504 oz. five years before. On the other hand the consumption in 1923 was 6,494 oz., divided as follows:

Iridium Consumption in 1922 and 1923

In Troy Ounces	1922	1923
Jewelry industries	2,588	3,073
Electrical industries	1,537	1,675
Chemical industries	172	190
Dental industries	83	153
Miscellaneous industries	1,064	1,403

This represents an increase of 772 oz. in electrical industries, and 706 oz. in jewelry, over that used in 1921. It may be said that practically the sole use of iridium is in hardening platinum, but here it is indispensable. As a matter of fact, virtually all platinum used in industry must contain iridium as a hardener, the amount needed varying from a few per cent in much laboratory ware, 10 to 15 per cent in electrical contacts, up to 30 per cent or even more in hypodermic needles. The iridium used in the jewelry industry is similarly for the purpose of hardening the platinum, which in a pure state does not possess sufficient strength and hardness for satisfactory work and for durability. For this use, however, it can be replaced by certain other metals.

It will be seen that the jewelry industry consumes at present nearly half the iridium used, and this use is increasing. Last year the use of iridium in jewelry nearly equaled, if indeed it did not surpass, the world's production. Though most native platinum contains a varying but always small amount of iridium, the most important source is iridosmium. This occurs in small quantities associated with platinum, and in a few places by itself. In few of these localities is the amount sufficient by itself to pay for working. In Tasmania alone are there washings which seem to be successful commercially, and here the production in 1920 was only 2,000 oz. Nor does there seem to be any prospect of any supply of iridium in the near future which will more than equal the industrial demand, to say nothing of that called for in jewelry.

The situation in respect to iridium today somewhat resembles that regarding platinum during the war, when the demand gave promise of almost immediately surpassing that absolutely required for war purposes. The situation would have been most critical had not the jewelers loyally pledged that the government should not have its work impeded for lack of platinum, even if they had to buy it back from their customers.

Minor Metals of Platinum Group Little Used

As for the other three metals of the platinum group, there is less to be said; they not only occur in smaller quantities, but they are separated in pure form in still smaller amounts. No statistics are given in the government report regarding them.

A small amount of rhodium is prepared in pure form to make the platinum-rhodium alloy used in thermocouples. Aside from this it may be said that rhodium has no industrial use, though its effect in hardening platinum seems to be much the same as that of iridium, as would be expected from the nature of the element and its place in the periodic table.

Osmium occurs in larger quantities and makes up half, more or less, of the native iridosmium. As an oxide it has a restricted but important use in microscopy, but I imagine the supply, small as it is, would be, say, a million times any possible demand. As a catalytic agent, both for reductions and for activating potassium chlorate in oxidations, it has great possibilities, but no prospect of any present use. As a hardener of platinum it possibly surpasses iridium, and would do much to stave off an iridium shortage, but unfortunately it oxidizes very readily at high temperatures, evolving the intensely disagreeable and poisonous osmium tetroxide. These fumes, which are given off when osmium alloys are melted, preclude the use of these alloys by those who are not specially equipped for this work. This ready oxidizability also precludes its use in platinum alloys for industrial electrolysis.

There remains of the platinum group of metals only ruthenium. This occurs in iridosmium in the smallest quantity of any metal of the group, and is rarely separated in pure form. Even were this not the case it would be of little value in alloys, owing to its resemblance to osmium in giving off a volatile oxide, which, though far from agreeable, is far less poisonous than that of osmium.

Adulterants in Platinum Alloys

There has been much agitation in recent months in the organs of the jewelry trade regarding the legitimacy of applying the name "platinum" to any of the alloys of platinum except to those containing iridium. The only reason for singling out this member of the platinum group as a legitimate "adulterant" of platinum is that at present its price ranges from two to three times the price of platinum.

Pure platinum, as we have seen, has neither strength nor hardness sufficient to make it durable in jewelry, but the addition of a small amount of any of the other members of the platinum group will give this desired hardness. The New York and Illinois statutes prescribe that jewelry stamped "Platinum" must contain 92.5 per cent of the metals of the group. There are two defects in this law; the first, that the other 7.5 per cent of the alloy not being specified, far too wide a latitude is allowed in the use of metals which do not compare with platinum in value; the second, that there is no specification as to the composition of 92.5 per cent except that it must be made up of platinum, iridium, osmium, palladium, rhodium or ruthenium, or these metals in combination. Thus, any possible combination of any of these metals, if making up 92.5 per cent of the alloy, could be legitimately stamped "Platinum."

As a matter of fact, the possible combinations and proportions which would give an alloy at the same time workable and durable are very limited. Iridium alone can be used, from 5 per cent up to perhaps 10 per cent, to harden the platinum; palladium can be used up to say 20 per cent or 25 per cent, provided a much smaller amount of iridium is used to increase the hardness; rhodium can be used partly or wholly to replace the iridium; ruthenium and osmium appear to be out of the question, on account of the inconvenience and even danger in remelting. It is said that palladium has a tendency to whiten the alloy, but it is very doubtful if even an experienced eye can detect any difference in color. As a matter of fact, all these alloys may be considered equally useful for jewelry, and the variation in cost from that of pure platinum is not large; just at present, it decreases with increasing amounts of palladium, and increases with increasing amounts of iridium and rhodium. This is, however, liable to change with the fluctuating prices of the different platinum metals. The basal price will be determined by the platinum, which should naturally make up the major portion of the alloy.

The crux of the whole matter is that though all these

metals are platinum metals and share the distinction of being the most noble and expensive metals put to industrial use, just now palladium happens to be a little lower priced than platinum, and iridium much higher priced. The price of these metals must be largely governed by the law of supply and demand, and from the statistics given herewith, consumption appears to be already surpassing production, and unless unexpected sources should increase the supply, which does not seem probable, the prices of all these metals can hardly be expected to become much lower.

The study of the fluctuations in price of platinum and the other metals of the group is of much interest. There are few commodities in which the price, within limits, is so sensitive and reacts so quickly to seemingly small influences.

In 1913 and 1914 the price of platinum was about $46 per troy ounce. With the outbreak of the war it rose to $48 and then slowly declined, until in May, 1915, it was quoted at $38. It then began to rise, and by the end of the year was $100. Then followed another decline, and in July, 1916, it reached a minimum of $60. An immediately following rise brought it to $110 in December. Owing to government control of prices, it remained steady throughout 1917 and 1918 at slightly above $100 ($108), but in the fall of 1919 it rose rapidly until the peak of $155 was reached in January, 1920. This price was of short duration, for in June it was quoted at $85, and though in August it rose again to $115, from then on it continued to fall, reaching the bottom of $65 in July of 1921. From this point in the course of a year it had gradually worked up to $118 in the early autumn of 1922, and has varied between this and $110 to the present time.

Fluctuations in Palladium Prices

Palladium, with its lesser uses, has fluctuated less rapidly than platinum, though its limits have been about the same, except that the price of palladium has never touched as low a point as did platinum in 1915. In the fall of 1913 palladium was quoted at $60, having been $46 during the first of the year, the same price as platinum. From $60 it fell gradually to $50, the point that platinum touched in September, 1915, when it was starting on its first great rise. With a few slight recessions, palladium reached its peak of $150 in December, 1918, being then $42 higher than platinum. It was a year later that platinum reached the same figure. Through 1919, 1920, and 1921 palladium slowly fell off to its minimum of $52 at the end of the last-named year. Since that time its price has gradually risen, especially during the spring of 1922, and has for a year ranged from $78 to $83. During the last ten years the price of palladium has been above that of platinum for about two-thirds of the time; for the balance platinum has been the higher. In February, 1922, it was about $39 higher.

The prices for iridium and rhodium are strongly affected by their limited, but, especially in the case of iridium, important, market. The supply is small, the difficulties of separation in a pure form are great, and in the case of rhodium the amount called for is nominal. From 1913 until this country entered the war iridium ranged from $150 to $250 an ounce. It then advanced materially, reaching $350 to $360 in 1919. In 1921 iridium declined to about $225, only to rise again to about $300, and is $270 to $280 at the present time. Rhodium from 1913 to 1916 varied from $75 to $150, but advanced along with iridium during 1917-1919, reaching $200 to $250. The latter decline carried it down to about $100, but it has again risen to its current price of $150 to $175.

These figures suffice to show that there is no ground for discrimination between the platinum metals from the standpoint of intrinsic value. They offer similar properties, and the rapidly fluctuating prices are merely a reflection of the balance between the limited supply and demand.

The passage of a national stamping law, as advocated by some, restricting the name "Platinum" to this metal and to this metal alloyed with iridium, could not fail to be disastrous. There is no more innate reason why an alloy of platinum with iridium should be stamped and called platinum than a similar alloy with rhodium or palladium or any other of the metals of the group. It is merely, at present, the most expensive alloy. This being the case, were a law enacted allowing this alone to be called platinum, other alloys, equally good but a little lower in price, would be driven into disrepute, for purchasers of platinum jewelry are influenced only by its price; few persons buy platinum jewelry for its intrinsic beauty.

Now, it can readily be seen that should iridium-platinum alone be used for jewelry, the demand for iridium simply for this purpose would far exceed any present or probable source of supply. Increasing prices would of course be to the advantage of the jeweler, for there seems to be an unlimited capacity in the jewelry market to absorb the most expensive jewelry, as there is to absorb diamonds. The effect of this on those scientific and other industries where the iridium-platinum alloy is indispensable can hardly be foreseen. Or rather, it can be foreseen that great hardship would be worked. This can only be obviated by allowing, and indeed encouraging, a limited amount of palladium (and rhodium) in jewelry platinum. Then, at least, this phase of the jewelry industry will less seriously impede scientific and industrial development.

Profits in Electrolytic Zinc

Electrolytic zinc—both the company and the metal bearing that name in Tasmania—is enjoying a profitable run, thanks to good management, cheap hydroelectric power, and an excellent market—namely, the British Government. During the year ended June 30 last, the Electrolytic Zinc Co. of Australasia made a profit of £395,769 (say $1,780,000 at $4.50 to £1). This exceeds that of 1922 by £200,000. Production amounted to 31,283 tons of 99.95 per cent zinc, also 4,344 tons of lead, 691,062 oz. of silver, and 78 tons of cadmium. The average daily production of zinc is now 120 tons, and over 30,000 hp. is being consumed. Broken Hill, New South Wales, supplies the zinc concentrates, which also provide the sulphuric acid used in the process; and the Tasmanian Government provides the power. Later on, the company's own mines in Tasmania will add to the supply of concentrates. The faith and influence of W. L. Baillieu, of Melbourne, led to the financing of this enterprise; while the technical ability of H. W. Gepp, who made some large tests on Broken Hill concentrates in America in 1917, has brought operations to the present stage. The plant at Risdon, Tasmania, has about half the capacity of that at Great Falls, Mont.; and these two with that at Trail, B. C., and at Park City, Utah, are the most important electrolytic zinc treatment plants in the world.

Record L.O.X. Blast at Pennsylvania Quarry

Four Thousand Five Hundred Tons of Rock Broken With 721 Pounds of Liquid Oxygen Explosive in Twelve Holes on a 30-Foot Bench

By F. W. O'Neil
Chief Engineer, Ingersoll-Rand Co.

ON MARCH 5, 1924, some preliminary blasting was done with liquid oxygen explosives, known as L.O.X., at Myerstown, Lebanon County, Pa., on the property of the Calcite Quarry Co. A second demonstration was carried out on April 11 by officials of the Air Reduction Co. and the Ingersoll-Rand Co. who had had to do not only with the designing and the construction of the Claude Process plant which furnished the liquid oxygen, but who also worked out the details for the application of L.O.X. to the blasting of churn-drill holes.

The object of the second demonstration was to conduct a complete blast in accordance with the usual procedure followed by the Calcite Quarry Co. in its routine operations. This took the form of a twelve-hole

Soaking tank, some of the cartridges used in the blast, and a few of the forty fifteen-liter transportation bottles in which the liquid oxygen was delivered at Myerstown

blast on a 30-ft. bench at one end of the quarry. The drill holes were spaced about 12 ft. apart, as indicated by one of the accompanying illustrations; each of these holes was 28 ft. deep and 5½ in. in diameter. The cartridges were 5 in. in diameter and 18 in. long—five of them being placed in each hole. For stemming, loose loam was poured into the holes, none of which was tamped.

The cartridge cases or bags were made of stout muslin and filled with finely divided carbonaceous material which was of a highly absorbent nature. Before soaking in the liquid oxygen, each dry cartridge, in its complete form, weighed 3.25 lb.—the entire lot of sixty cartridges used in the blast weighing in this state 195 lb. Each unit of oxygen requires for its complete combustion to carbon dioxide a total of 2.66 units of oxygen. However, the ratio of absorption in the cartridges employed at Myerstown was 3.5 units of oxygen —the excess allowing a longer period in which to load the holes and to make other preparations before evaporation brought the explosive to the theoretical point. Indeed, less oxygen than the theoretical amount required can be used without materially diminishing the force of the explosion. Explosive action with cartridges of the kind in question can be obtained any time within two hours after they have been saturated and placed in the drill holes ready for detonating.

The liquid oxygen required for the demonstrating blast was delivered at Myerstown in forty fifteen-liter transportation bottles—the outward character of which can be seen in the illustration on this page. These containers are so constructed that they minimize evaporation of their liquid-oxygen content while in storage or in transit. When filled and ready for shipment, early in the evening of April 7, the net weight of oxygen in the bottles was 1,541 lb. When the containers reached their destination in the forenoon of April 11, they held 1,014 lb.—a loss of 527 lb., or 34 per cent, in eighty-eight hours. In other words, there was sustained by evaporation a loss of 9.3 per cent for each twenty-four hours.

When the soaking of the cartridges was begun there was available, therefore, 1,014 lb. of liquid oxygen. Sixty-one cartridges were soaked, although but sixty of them were actually utilized for the blast. Each cartridge absorbed substantially 15 lb. of the fluid, and the whole lot required 921 lb. for their saturation. The theoretical weight, based upon the 2.66 ratio per unit of carbon, is 525 lb.; and, therefore, the oxygen factor in this demonstration was 1.75—to insure the cartridges being above or at the carbon-dioxide point after the lapse of a considerable period following their withdrawal from the soaking vessel.

The soaking vessels used abroad are not large enough to accommodate at one time more than a single cartridge of the size fired at Myerstown—the European cartridges being much smaller. This restriction is objectionable, as any practical man can readily appreciate, because of the time that would be required to soak a large enough number of cartridges to meet the needs of a sizable round. To overcome this difficulty and to make it feasible to soak simultaneously twenty or more cartridges, an insulated tank was built for the quarry demonstration. This was a double-walled box-like affair having the interspace filled with felt and the soaking chamber lined with copper. The photograph on this page plainly shows the simple character of this tank. The container proved entirely satisfactory, the loss of liquid oxygen by evaporation being surprisingly low.

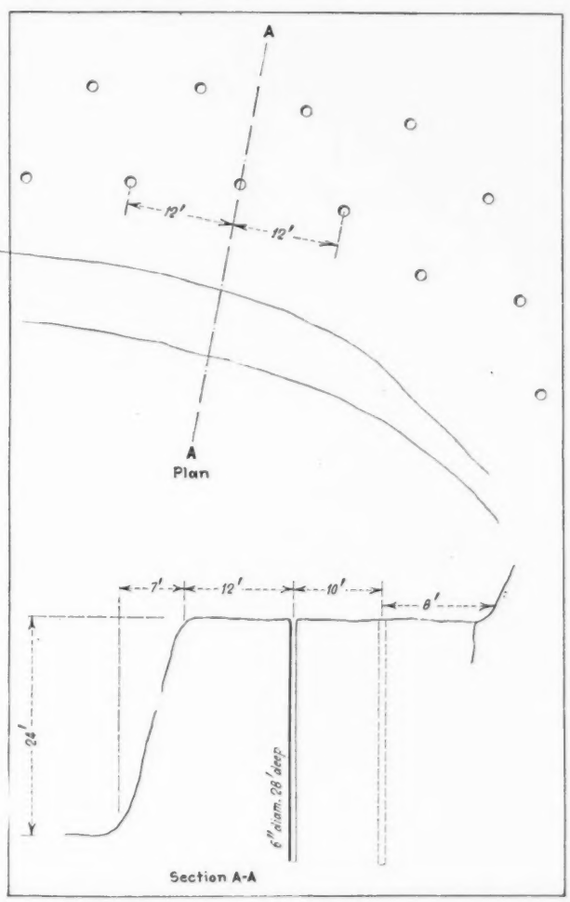
The cartridges were soaked about thirty minutes. In the first lot, thirty-five of them were so dealt with—enough to load seven holes. Then a second batch consisting of twenty-five cartridges was soaked, and when ready these were used to load the five holes remaining. The time intervals were as follows: Started to withdraw the first batch of cartridges from the liquid at 2 p.m.; and the first set of seven holes was completely

loaded by 2:30. Started to soak the second batch at 2:20; and the remaining five holes were loaded at 3:05.

All twelve holes were shot in unison at 3:35. There was intentionally a lapse of thirty minutes between the time the cartridges were in place in the twelve holes and the moment of firing. In fact, there was a total interval of one hour thirty-five minutes from the moment the first cartridges were taken out of the liquid oxygen until the blast was set off. This point is an important one, for it emphasizes that large quantities of L.O.X. can be used for a single blast and ample time allowed for the deliberate placing of the cartridges, for doing the needful stemming, and for making what other arrangements may be necessary to insure thoroughly effective results.

To fire the cartridges, a suitable length of TNT Cordeau was hung in each hole from top to bottom and the twelve lengths of Cordeau were connected above ground to a common trunk—a single cap on the trunk fuse serving to set off all the charges at the same instant when detonated electrically. According to officials of the Calcite Quarry Co., for a similar blast under ordinary conditions they would use 85 lb. of 40 per cent dynamite in each hole, or a total of 1,020 lb.

It was estimated that 4,500 tons of rock were broken by the blast, or 6.2 tons per pound of L.O.X. employed. Had 1,020 lb. of dynamite been used instead, and a like quantity of rock broken, this would have meant 4.4 tons of rock for each pound of explosive. It was the opinion of those in charge of the demonstration that the blast was overshot and that the same result could have been obtained with 20 per cent less L.O.X.



Plan and section of the drill holes

A close-up of the bench prior to the blast. The dark patches are the clayey red loam used for stemming. The twelve drill holes are indicated by the projecting collars

After the blast, about fifteen sizable boulders were blockholed, using in each boulder a cartridge 1¼ in. in diameter and 5-in. long. The explosive broke up the boulders into small fragments. It was conclusively determined by setting some L.O.X cartridges off with fuses, that they cannot be detonated in the open air by a fuse, but that they will, instead, burn rapidly, with a bright flame.

Assuming the total weight of the sixty cartridges to be 721 lb. at the carbon-dioxide point, and putting the cost of the L.O.X. at 8c. a pound—which is ample to cover fixed charges and loss by evaporation—the total cost was $57.68. On the other hand, 1,020 lb. of dynamite at 13.25c. a pound would cost $135.15. At these rates, the expenditure for L.O.X. for each ton of rock broken was 1.28c., compared with 3c. for dynamite. If the assumption be correct that the blast was overshot 20 per cent, the cost of L.O.X. would be 34 per cent of that of dynamite.

A marked feature of the effect of the blast was a somewhat pronounced crater formed at the foot of the quarry face when the bench was lifted. This cavity served admirably to indicate the downward force exerted by the L.O.X.; and the measure of this reaction is especially noteworthy when it is recalled that the loam used for stemming was not tamped at all but merely poured into the holes. This stemming was a red clayey earth which photographed black in some of the pictures; and the dust from this stemming was responsible for the density of the cloud blown skyward at the time of the blast.

The liquid oxygen used in this significant demonstration was produced by a plant operating under the Claude system—the system adopted by the Ingersoll-Rand company for the manufacture of liquid oxygen in large quantities. This system has been developed by the renown French physicist, Dr. Georges Claude; and one of the distinctive characteristics of it is that it is necessary to compress atmospheric air to only 1,000 lb. or possibly less to produce liquid oxygen. By other systems in use, the air must be subjected to an initial pressure of 3,500 lb. before liquefaction is accomplished. The greater efficiency and economy of the Claude process should, therefore, be self-evident.

The L.O.X. blast at Myerstown was the first of its kind on a commercial scale ever made in a quarry in the United States; and there are the best of reasons for believing that it was the largest blast of liquid-oxygen explosives so far set off anywhere. It was the climax of much work, and marked the overcoming of many obstacles.

South Lorrain, Canada's Newest Silver Bonanza

The Keeley mine, in South Lorrain, 18 miles southeast of Cobalt, Ontario, played havoc with the fortunes of a Toronto bank and even put its manager in jail, as related in a handbook just issued by the Ontario Department of Mines. At a sale of the bank's assets the mine brought $100,000. The manager of the English company which bought it, James Mackintosh Bell, diagnosed the geology of the property as indicating a strong probablilty of ore a short distance away from the old workings. A shaft was sunk and the hopes entertained were more than realized. A veritable treasure chamber of ore was struck, in large quantity and of a richness equal to any which Cobalt proper produced in its palmiest days. Keeley is now producing at the rate of 135,000 oz., or more, of silver per month, and is continuing to find good ore as the shaft descends.

The principal vein—the Woods—is situated on a fault contact, and the oreshoots are much wider than those of Cobalt, though shorter. One block of ore was purchased by the Ontario Government as a memento of this rich deposit of silver. It weighs 4,402 lb., is 3 ft. long, 3 ft. high, and 2 ft. wide, and is estimated to contain 24,211 oz. of silver. The purchase price, at 64½c. per oz. for silver, was $15,616. This block is now on display in the Mineral Section of the Canadian Building at the British Empire Exhibition, and is believed to be the largest and most valuable single piece of silver ore ever produced in the British Empire, or perhaps in the world.

The Frontier mine, adjoining the Keeley, passed into the hands of the Mining Corporation of Canada, which found that the Woods vein crossed into its ground, and is now duplicating the experience of the Keeley mine, some of the ore brought up consisting of large plates or masses of solid silver. In 1923 Keeley shipped 1,655,323 oz., and Frontier 1,300,323 oz. of silver.

It is believed that other faults occur in South Lorrain, and that on the many undeveloped claims in that locality there are good prospects of finding additional deposits of ore. Lorrain Trout Lake Mines, south of the Frontier; Huronian Belt Co., on the Maidens claims near the lake, and other companies are at work, so South Lorrain is likely to be an active camp for the next few seasons.

One Phase of Present Day Gold Mining in Alaska

An operation typical of the creek placers in the Fairbanks district

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Some Reflections on the American Copper Industry and the Proposed Tariff

THE EDITOR:

Sir—Articles which you have recently published relative to the copper industry, arguments for and against the proposed tariff, and Mr. Notman's comparison of costs between South American copper and the production of certain American companies, are all very interesting, but I do not think that they have yet brought out the real situation in our American copper industry or the difficulty of improving the situation by a tariff or any other artificial means.

Mr. Notman aims to show that the more favored American producers can compete on even terms with the bulk of the South American production and infers that the same is true with respect to the increasing production from Africa. I think his conclusions are correct as far as they go.

From such statements as have recently been published it appears that the United States is producing primary copper this year at the rate of approximately 1,500,000,000 lb., and that our exports of copper are still in excess of our imports, although the difference between exports and imports is rapidly diminishing.

Now, considering the American production from the standpoint of costs, the principal copper producers can be divided into three groups, which I shall call "A," "B," and "C."

Group "A"—The companies under Group "A" are producing copper for less than 10c. per pound, including all costs and reasonable charges for depletion and depreciation. The output from this class of properties is at the rate of 500,000,000 lb. for this year, or one-third of the total production. The mines from which this copper is taken are favored by nature and either contain ores of especially high grade, such as the United Verde, Kennecott, and Magma, and generally with substantial content in precious metals, or, like the Utah Copper and New Cornelia, they contain enormous reserves of low-grade ore which can be mined and treated very cheaply. In either case the net result is the same.

The companies which own and operate these mines are strong and well financed. They have extensive ore reserves developed to provide for the future. They have magnificent mining and treatment plants maintained at the highest point of efficiency, and they find that their lowest costs per pound of copper are realized by producing to the maximum of their capacity. These companies are not really suffering, even though copper sells at 12½c. per pound. For the most part they are still paying dividends; many of them are actually increasing their output and have recently raised wages, and they have programs for expansion which will permit them, when they desire, greatly to increase their present production, and even, in some cases, to double it. The bogey of the South American and African competition need not trouble them.

Group "B"—The copper companies in Group "B" are producing at a cost of from 10 to 13c. per pound, and the total of their production may be estimated for 1924 at approximately 650,000,000 lb., if they keep on producing as they did during the first quarter of this year. The companies in Group "B" are also well equipped, their ore reserves are large, and, to keep down their unit costs, they must maintain a certain rate of production, although some of them have curtailed by shutting down part of their mines from which the lower grade ore is produced, or by operating less than full time. For the most part, however, they are working close to normal capacity, and they have been expending large sums to improve efficiency, which has tended to increase, rather than to decrease, their output in pounds of copper.

These companies are in a very different position from those in Group "A." They do not like the present situation. They are seriously worried lest it should continue long enough greatly to decrease the value of their property and their plants. They have really not earned any profit since 1918, and they are not earning any profit today, but are depleting their ore reserves without adequate return, and if conditions do not soon improve, they will greatly impair their chances of repaying to the stockholders the original investment. These companies justly fear the competition with South America and Africa, for if it is not hurting them today it will surely do so in the near future, and a tariff to protect their interests would seem wise and right, although it might have no bearing on the present situation.

Group "C"—The companies in Group "C" are producing copper for more than 13c. per pound. Some of them are running as high as 15c., and signals of distress have been flying during the last year. The total of the production from Group "C" will be about 350,000,000 lb. for 1924 if the present rate is maintained.

These companies have been losing money since 1918. At the present time they ought to be shut down, for they are not only wasting their ore reserves but are depleting their cash at the same time; but, on the other hand, the loss in operations is offset against the tremendously heavy carrying charges and maintenance, the deterioration of a shutdown mining and smelting plant, and the expense of re-forming an organization when operations are to be resumed. Every one had sad experience with these expenses in 1921, and rather than repeat such experience these companies are holding on, hoping for some change for the better, which they believe may be brought about through the enactment of a tariff or through the broadening of the European market. To allow these companies a living return, and the American copper industry, as a whole, a fair margin of profit, a market of not less than 18c. should be established and maintained.

Now, since 1913, the items of cost which go into the production of copper, particularly labor, fuel, explosives, taxes, and transportation charges, have increased on the average probably 50 per cent. The purchasing power of the dollar, compared to an index of 100 in 1913, is now 66, and yet the average price of copper for the ten years ended in 1913 was 14.54c. per pound, which would represent a price of 22c. based on the purchasing power of the dollar in 1923. Actually copper sold for 12½c. last week and has averaged around 13c. for the last six months, and perhaps it is the only American produced commodity which has been selling at 10 per cent less than pre-war average, yet our exports have always exceeded our imports of copper and the foreign production has not so far competed with the American product. Then why does copper hold this unique and unfortunate position?

The answer to this question may form the subject of a pretty heated discussion, but I make bold to say that it is not foreign competition, but domestic competition, which is the root of the whole evil, and the cause of the present disproportionate copper price, and that this domestic competition is made possible by the overequipment of the copper industry, which came about during war time, and the tremendous variation in the cost of producing copper which gives so great in advantage to the low-cost producers as compared to the others. Conditions have changed since the war, for there have been great advances in methods of mining and especially in metallurgy, and immense sums have been spent to develop and equip the best mines and those which can produce the greatest quantity of copper at the lowest figures; therefore, the increase in copper production has been greatest from the properties in Group "A"; and since the lowest working costs are always secured by the greatest production, the tendency is for these most-favored companies to keep on steadily increasing their output, almost regardless of the price for which their copper is sold and entirely regardless of the general welfare of the industry.

Let us suppose that a tariff of 6c. per pound is placed on foreign copper, but that this copper may still pass through the United States for refining in bond and that the foreign production equals, as it will in a very short time, the total foreign demand for copper, while the sale of American copper is practically restricted to the United States, since it will not be able to compete in Europe on even terms with the low-cost copper produced in South America and Africa.

Even so, if the mines in Group "A" continue to increase their production, and if the Group "B" mines continue to operate to full capacity, these two groups, between them, could supply all the American demand, and there is no guarantee that anything more than a fractional rise in price would result until the time comes, some years hence, when the great bulk of the low-cost copper is exhausted.

Opinions differ as to the total reserves of copper in the United States, and probably it is impossible to make any intelligent estimate at the present time, for even if no large new orebodies are developed, the advances in metallurgy are likely to make it possible to treat with profit many orebodies which at present are considered merely mineralized ground. But I think that all will agree that, if American consumption continues to increase at its present rate, it will be impossible for the American production to supply the home market ten years hence at anything like the present price and the market will then have to be supplied through the revival of the high-cost producers, or through importing copper from other countries and paying the duty.

Under these conditions, there are several considerations which should be given due weight in determining the policy of, and to, the copper producers, not only from a business standpoint but from the standpoint of the national welfare.

Aside from the recovery of scrap, copper is a wasting asset; like petroleum, once it is gone it cannot be replaced; yet the prospect of the exhaustion of copper and petroleum does not seem to cause the same apprehension as the annihilation of our forests, though forests can be grown again, after a proper interval of time.

Copper is a national asset. In time of peace it is vital to the progress of our industries, and more particularly to the progress of the electrical industry, where it serves a purpose for which there are no satisfactory substitutes. In time of war it is vital, and in 1916 Ambassador Page wrote that, much as England valued the friendship of the United States, they would forfeit that friendship and even risk war rather than allow American copper to enter Germany. American copper which supplied the Allies was one of the very important factors in determining the result of the world-wide conflict.

Under these circumstances one may well question whether it is advisable that any more American copper should be exported to supply a foreign demand, since the American demand alone promises to increase so much faster than the production. Some have expressed fear that if copper sold at a relatively high price—say 18c. per pound—it would be replaced by other metals, and notably aluminum. Since the supply of aluminum is practically inexhaustible, why would it not be better policy to let aluminum substitute wherever it can and confine the uses of copper to those purposes for which no other metal will take its place?

I am of the opinion that the trouble with the copper industry is due to the overproduction of the metal by the most-favored producers in the United States and their continuous desire to further increase and sell their product, even at a figure which cannot be justified from any business standpoint.

A combination in restraint of trade is contrary to our laws, but what can be said concerning a competition which has been carried on for five years to the practical ruination of a large part of a great industry and which, if continued, will eventually place the United States in an absolutely dependent position as far as copper is concerned, whether for war or peace? It seems as if the same business reasoning might appeal to all the heads of the copper industry, irrespective of the producing costs of the particular properties in which they are interested, for obviously it would be better that a certain company should produce 70,000,000 lb. of copper at a cost of 10c. and sell it for 18c., than to produce 100,000,000 lb. at a cost of 8c. and sell it for 13c. The actual profit would be greater, the exhaustion of the mine would be less, and the stockholders would receive better returns on their investment.

If the present competition continues, it is hardly likely that investors will look with favor upon an industry which, as a whole, is so obviously mismanaged that only a small percentage of those who are engaged in it can earn any profit at all and where two-thirds of the entire product is sold at or near cost. It is almost equally certain that the plight of the copper industry

will eventually attract the attention of those who favor conservation of our national resources and government regulation of private business.

Therefore, I respectfully suggest that in advocating a tariff, those who are interested should first demonstrate that this tariff will actually help the bulk of the American producers and not merely those few companies which are today least in need of tariff protection and which may, within the next five years, supply the entire American market to the exclusion of all other less-favored domestic competitors.

Humboldt, Ariz. G. M. COLVOCORESSES.

Mining Investments

THE EDITOR:

Sir—Mining, one of the safest investments on earth, has become one of the most risky. This is caused by the way people are swindled by the fake stock salesmen and by the fake companies who pretend to sell stock.

A man can have an honest project, and yet he cannot get that project to the people. He will not violate the law, and that is the reason. A crook can have a fake project and get all the money he wants. He violates the law, and when he is caught, he many times divies up with some lawyer, or some one, and gets off. People know this, and when the only mining stock they are offered is either fake mining stock, or stock that they do not know is not, they naturally put their money into other securities.

If the Post Office authorities would rout out the fake mining people, by the laws that they are supposed to enforce, there would be no trouble in financing mines, and there would be no trouble in financing any honest investment, but they seem to be either unable or unwilling to act on fake investments, which makes the honest investments suffer, as the fake investments offer more, and their offers are backed up by photos of abstracts of titles, of engineer's reports, and of other things.

The ordinary man cannot tell the fake from the genuine, and so the banks refuse to handle mining stock, save in rare instances, and the very people who would invest heavily in mines put their investments in real estate, and allow the so-called suckers to invest.

If the government is not going to enforce its corporation laws, its laws for obtaining money under false pretenses, it should in duty to honest government repeal these laws, and allow the public to know it, so that they could investigate, and see for their own selves which were genuine mining investments and which were faked; but when they know the laws, and know the oaths of office that the government officials take, they are lulled into a false safe investment idea, and drop all they have frequently on the rankest kind of fakes.

If we had honest officials there would be enough money to finance our mines. If we had it understood that "buyers must beware," we would also have enough to finance every investment.

I am sure we cannot go on forever, with one law for honest men, honest mines, and another and diametrically different one for the dishonest promoters, the dishonest men who swindle the suckers.

When we realize this, and not till then, will the honest miners, and the honest prospectors, and the honest stock brokers, have all the money they require for their every need, for there is that supply, and all that is necessary is to dump the crooks overboard, and the money will come in from North, East, South, and West, from Europe, America, and Africa, as it is there ready for honest investments now, but that money will not be invested where the investors have no say as to how it shall be used, or as to whether it shall be squandered by others or not, for they own the money, and on real estate they are given the right to say what shall be done with their money, to a greater extent than in corporations. B. YORKSTONE HOGG.

Fort Pierce, Fla.

Ants as Indicators

THE EDITOR:

Sir—Recently I read an article in your journal, and I thought that someone was very stingy with information concerning prospecting. This old miner knows that some day his two-cycle vehicle known as the human body will blow up. He will certainly leave every earthly possession behind, even the trails he has blazed. And I believe it is rank robbery to put in cold storage any information that will help our fellow man and prospector.

Referring to the South Africander prospector that discovered platinum near an ant hill, I will remark that I found Indian beads on the plains of Colorado, on an ant hill; and with some exploring, it turned out to be an Indian graveyard.

By close observation I find that ants will decorate their homes with all kinds of bright objects that are within a radius of 10 ft., more or less, of their shaft, such as quartz and fine gold. On the desert in the dry placer fields where there are indications of placers, such as hematite, nuggets, etc., the Yaqui and the Mexican miner always pan the ant hills that are located in the supposed pay dirt country.

Well, come on, old timer, loosen up! Don't be a land terrapin. Remember you leave everything behind, when Mr. Gabriel blows his horn. E. B. FOSTER.

Kingman, Ariz.

Stamping Platinum

THE EDITOR:

Sir—Anent J. M. Hill's communication in your issue of June 21, entitled "Commercial Definition of Platinum," in which he calls attention to his article in your issue of May 17, would it not be simpler in the case of platinum to follow the method adopted for gold jewelry?

For example, 22-k. gold means that the article so stamped is $\frac{22}{24}$ fine; $\frac{22}{24}$ is 91⅔ per cent, which is the fineness of British standard gold. Similarly, 20-k. is 83⅓ per cent gold; 18-k. is 75 per cent; 16-k. is 66⅔ per cent; and 14-k. is 58⅓ per cent. And we sometimes see articles containing 58⅓ per cent gold advertised as "14-k. *solid* gold"! Since the public is reasonably familiar with the symbol K on gold jewelry—the color of which indicates the metal of which it is largely composed—it has become a "hallmark" for purity, the degree of purity being indicated by the numerals preceding the symbol K.

In the case of platinum, 18-k. Pt. would mean platinum 75 per cent pure; and so on. The abbreviations for iridium, palladium, and so on suggested in the article of May 17 could be materially shortened without injuring their respective meanings.

New York. W. DE L. BENEDICT.

Consultation

Safe Practice in Discarding Steel Hoisting Rope

Methods Not Standardized, Owing to Indeterminate Factors

"To what, if any, extent has there been any standardization of methods of determining when a steel hoisting rope should be discarded? What is the general practice in this regard?"

There is no standardization of methods for determining when a steel hoisting rope should be discarded. A report of the U. S. Bureau of Mines contained in Technical Paper No. 237, entitled "Safe Practice in Using Wire Ropes in Mines," sums up the situation in the following words:

"No standard rules for discarding ropes have been made; they vary with different conditions and in different localities. Various rules for discarding ropes are based on (a) the stretch of the rope, (b) the number of broken wires in a given length of rope or of the entire rope, (c) the amount of wear of the wires at the crown of the strands, (d) the length of time the rope has been in service, (e) the number of trips, (f) the tonnage, or (g) the ton-miles hoisted by the rope.

"In the absence of more definite rules for discarding ropes, according to American practice, the following, quoted from 'Rules and Regulations for Metal Mines,' are suggested:

> "'Safety factors must never fall below 4.5. Ropes of standard construction shall be discarded when there are six broken wires in one rope lay, when wires on crown are worn to 65 per cent of their original diameter, when there are more than three broken wires reduced by wear more than 30 per cent in cross section, and when marked corrosion appears.'

"Whatever rules are made, they should always err on the side of safety rather than on the side of a long life for the rope. The cost of even a slight accident will almost always be greater than the cost of a new rope."

A paper by James F. Howe entitled "Use of Wire Rope in Mining Operations," and published in the *Transactions* of the A.I.M.E., contains some interesting observations on the life of wire rope and deteriorating influences. In answering the question of the time for removal of the rope, the author replies that test of the worst worn or broken portions of the rope condemned or taken off will determine that. South African mining law provides for a test every six months of the piece cut off when the rope is resocketed. Whenever this test shows the strength of the rope is below that required by law, the rope must be removed and a new one put on. In the United States, according to Howe, state mine inspectors have the authority to order a rope taken off, if, in their opinion, it is unsafe to use. In one of the largest metal mines in the United States a workman inspects the main hoist rope each day, and if he pronounces the rope unsafe, not a man goes into the mine until the rope has been replaced with a new one. In almost all cases, the rope replacement is done on an arbitrary basis. Seldom is a piece of the rope tested, and the user is frequently groping around in the dark as to the exact facts.

The author makes reference to the fact that rope strength increases for a time after a rope goes into service. "In one case a 1½-in. 6 x 19 rope showed a higher strength on a section cut from the worst worn section than was secured from a piece cut from the end next to the drum, where there was no wear, and yet it was deemed necessary to take off the rope as unsafe."

The safety factor in a wire rope will be reduced by the following causes: (1) External wear; (2) breakage of individual wires; (3) corrosion by acid water, alkali water, electrolysis; (4) loss of elasticity; (5) fatigue in metal composing wires from regular or reverse bending, load variations caused by shocks due to starting, stopping or overloading, and torsion at or near attachments."

Recent Mexican Production Taxes on Silver Ore

"Will you kindly advise just what is meant in the third paragraph of the Mexico City letter, which occurs on page 501 of your issue of March 22, relative to Mexican taxes on silver ore? Does this mean 6.5 per cent or 6.5c. per oz., and so on, and is the tax increased 5 per cent additional, making, say, 11.5 per cent for each 10c. per fraction above 60c., or is it an addition of 5 per cent of the tax as figured on the 60c. per ounce basis? This seems somewhat ambiguous to us."

The tax is a sliding one based on the market quotation for silver. When silver is below 60c. an ounce, the tax on ore will be 6½ per cent of the value of the silver; when the market quotation is between 60c. and 70c. the tax will be 7 per cent; when it is between 70c. and 80c. the tax will be 7½ per cent, with similar gradations on upward to one dollar. Should silver go above one dollar the increment will be 1 per cent instead of ½ per cent for each 10c. or fraction thereof. The same gradations apply on concentrates, doré bullion, and refined metal, except that the bases when silver is under 60c. are 6 per cent, 5½ per cent, and 5 per cent respectively. The idea of this scale manifestly is to encourage the smelting and refining of ore and bullion in Mexico.

No Domestic Outlet for Nickel-Cobalt Ore

"Please give me the names and addresses of companies purchasing nickel-cobalt ores. I can ship by water."
(Inquiry from Mexico.)

There is practically no market for nickel-cobalt ore in the United States. None of the smelters along the Eastern seaboard are equipped to handle it, though some of them would no doubt be willing to take it for the silver content, provided it was appreciable and only a small proportion of nickel and cobalt were present.

All of the nickel and cobalt sold in this country is mined and smelted in Ontario, Canada, by companies situated inland, to whom it would hardly pay you to ship. This is excepting a small amount of nickel refined in New Jersey from imported matte, and a very small amount recovered as a byproduct in the refining of copper.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

THE POLISH GOVERNMENT has bought 3,200,000 oz. of silver from American producers. The silver is to be coined into "zlotys" in the United States and shipped abroad.

Fire in the shaft of the Arizona Commercial Mining Co. has affected operations in surrounding mines.

The East Butte Davis-Daly suit has been transferred to a federal court.

The Consolidated Mining & Smelting Co., of Canada, has been sued by the French Complex Ore Co. on the ground of patent infringement.

The Mohawk Mining Co., in Michigan, is installing a regrinding unit to increase its extraction.

War Minerals awards are almost completed.

Shipments of zinc from the Trail smelter are increasing.

Keno Hill is to erect a 100-ton mill on its property.

The Department of Commerce has established a new minerals division which will devote especial attention to non-ferrous metals.

Wright-Hargreaves has made a promising strike in its holdings.

Bunker Hill & Sullivan's Wood River development looks encouraging.

The Iron King, in Utah, will sink a new shaft.

United Comstock and Comstock Merger May Combine

Reports are current that there is to be a consolidation of the United Comstock Mines Co. and the Comstock Merger Mines Co. Officials of both companies have been in conference in Virginia City. Hugh Rose has been in Virginia City and is handling negotiations for his company, the Goldfield American Development Co., which controls the Comstock Merger.

The Merger is still developing below the Hale and Norcross tunnel level, and a large tonnage of ore of mill grade is reported to be available. The United Comstock mill is operating as usual, treating around 1,400 tons of ore per day, the major part of the ore coming from Imperial and Yellow Jacket territory.

Fire in Arizona Commercial Shaft Affects Surrounding Mines

Fire was discovered in the Eureka shaft of the Arizona Commercial Mining Co., at Globe, Ariz., on June 20, and, although it is now confined to a small area, the smoke and gases were so intense for several days that the adjoining mines were forced to suspend operations. The Eureka workings connected on the west end of the property with the Iron Cap Copper Co.'s mine, and connection is made at the eastern end with the drifts of the Superior & Boston Copper Co.

No work has been done at the Eureka shaft for several years, but only recently a small force were put on development. No evidence of the fire was noticeable at the collar, since the shaft is downcast, and the shift was lowered into the fire area before the fact was known. Immediate response by the district mine rescue crews resulted in quick control of the blaze, and it was thought that the fire was practically out, when the starting of a fan in an adjoining mine, whose operators were unaware of the existence of the danger, caused the fire to break out with renewed vigor. Helmet crews worked continuously for about forty-eight hours constructing bulkheads that shut off the smoke from the Iron Cap and Superior and Boston mines, permitting these properties to operate again, and water was turned down the Eureka shaft to maintain a downcast current of air and attack the fire.

The area burning is between the 700 and 1,200 levels and it is believed the fire will soon be smothered. Though there have been no serious mine fires in the Globe-Miami district for many years, several small outbreaks have occurred, which, without the prompt and efficient handling by the trained crews from the rescue station, might have proved disastrous.

White Caps Shaft Down 975 Feet

The incline shaft of the White Caps Mining Co., at Manhattan, Nev., has already been sunk 75 ft. below the 900 level. Plans, as announced, are to sink to a depth of 500 ft. below the 900 level and to develop the orebodies at that depth, in the hope that the ore will prove less refractory than as found on the upper levels.

Larger Zinc Shipments Made by Consolidated M. & S. Co.

The shipments of zinc concentrate and zinc bars by the Consolidated Mining & Smelting Co. are beginning to assume far larger proportion than at first was anticipated. The following dates have been booked for July and August: July 18, German steamer "Alricd"; July 25, Norwegian steamer "Strickland"; July 27, German steamer "Hessen"; Aug. 8, German steamer "Kermit"; Aug. 23, Norwegian steamer "Holger." Each boat will be loaded at New Westminster and will take approximately 3,000 tons of zinc concentrate and bars for Antwerp, from British Columbia.

Bunker Hill & Sullivan's Work in Wood River District Promising

After four years of exploration work on the Jay Gould and Red Elephant properties near Hailey in the Wood River district of southern Idaho, the Bunker Hill & Sullivan Mining & Concentrating Co. has been rewarded in its efforts by announcement that ore has been struck in the workings.

The orebody is probably not large, according to reports of the company, but it may have a bearing in stimulating the exploration further. The ores in the property are high-grade silver-lead deposits.

The Federal Mining & Smelting Co., which has been trying to solve the geological problems in the Minnie Moore property, in the same district, after the expenditure of more than $100,000 has abandoned the enterprise.

Polish Government Purchases 3,200,000 oz. of Silver From American Producers

Metal Is To Be Used for Coinage Purposes

By Felix Edgar Wormser
Assistant Editor

AMERICAN silver producers have sold 3,200,000 oz. of silver to the Polish Government for coinage purposes. The sale was made June 17, but negotiations were not concluded until June 27. Parties to the transaction were the Polish Government, acting through its envoy, Dr. Wroblewski, in the United States, and the American Smelting & Refining Co., the Anaconda Copper Mining Co., the United States Smelting, Refining & Mining Co., and the American Metal Co. The first three companies share equally in the sales quota allotted to each; the American Metal Co. has agreed to sell only a small proportion of the silver. The United States Government will play an important rôle in the execution of the order, because the silver sold to Poland will be coined by the U. S. Mint into "zlotys"—the name of the principal Polish silver coin—before being shipped abroad.

This sale is one of the largest peacetime transactions ever directly made by American producers, and it was concluded primarily with the object of promoting the resumption of the use of silver for coinage purposes in Europe—an outlet for silver that appears promising now that various European governments are turning more and more to the use of hard instead of the current paper money. The U. S. Government has frequently minted silver and gold coins for other nations at cost, and its action in this case merely follows international custom and courtesy. A total of 18,000,000 pieces will be coined; 12,000,000 are to be one-zloty pieces and 6,000,000 two-zloty pieces. A zloty is the official coin of Poland and consists of silver 750 fine in which the alloying metal is copper. It has a weight of 77.16 grains and a face value of 19.3c. gold. The copper necessary for coinage has also been sold by the producers to the Polish Government. Final arrangements require the producers to furnish the copper and silver to the U. S. Mint as called for. They will receive in return the zloty coins suitably packed and will then ship them to Warsaw.

The price paid for the silver has not been announced. One price was made to cover the whole transaction. Such charges as the cost of coining, packing, transportation, insurance, and miscellaneous items are to be paid by the Polish Government. Settlement for the silver sold is to be made upon delivery of the coins in Warsaw.

In carrying out negotiations and arranging details of the sale the assistance of several branches of the U. S. Government was most helpful, especially the efforts of the Treasury Department, the State Department and the Shipping Board.

The transaction was handled by a subcommittee of the Silver Committee appointed by the Reno Silver Conference called by the U. S. Senate Gold and Silver Committee last summer. It is understood that the producers have made this contract at this time for the purpose of testing the possibility of disposing of a considerable amount of silver in this manner. If the transaction results satisfactorily to the Polish Government, it is expected that a large amount of silver will be used in this way, in which event it is proposed to call upon the entire silver industry of the United States to take its pro-rata proportion of such shipments. The subject will doubtless be discussed at the reconvening of the silver conference which has been called to meet at Salt Lake City on Aug. 6.

Non-resident Mine Owner Wins British Columbia Income Tax Case

The British Columbia Government has been defeated in the Canadian Supreme Court in an attempt to collect income tax from non-resident mine owners after having accepted a lump sum in payment of taxes in lieu of all other taxation for past income earned.

The facts in this case were that Senator Kent, of Kentfield, Calif., had entered a partnership with "Surprise Smith" on the Surprise mine, at Sandon, on which they carried on development for twenty years, with no returns until finally the ore was opened in a long raise by Smith, from which he was named. When the value of the property was proven Kent bought out Smith and became sole owner and accumulated considerable earning in the years 1915 and 1917, on which he paid the usual 2 per cent tax, which under the taxation act was in lieu of all other taxes, his payment being around $13,000 for the two years, which was the full amount of tax due from him, as non-resident mine owners were not then required to pay income tax. Subsequently Kent reorganized as the Roseberry Surprise, he being the largest shareholder.

In 1918 an amendment was added to the taxation act making non-resident owners liable for income derived from mines, and in 1920 a further amendment to the act provided that the act was retroactive for the last five years, which brought the operations of Senator Kent of 1915 and 1917 under the new act, though he had paid all taxes under the law as it existed in those years. When the assessments were made against him he appealed to the Court of Revision at Kaslo, which confirmed the assessment, and the case was confirmed through the higher courts until its final reversal in the Canadian Supreme Court.

Rouyn District Inspected by Railroad Men

Considerable importance is attached to the recent visit of members of the Quebec Cabinet to the Rouyn gold district; at the same time Canadian Pacific Ry. officials, including the smelter expert, also visited the field. It is hoped that this may lead to the extension of the C. P. R. into Rouyn. The most important property to date is the Horne claims belonging to the Noranda Syndicate, where a substantial tonnage of high-grade copper and gold ore has been indicated by diamond drilling. To handle this ore successfully adequate railway facilities are essential. Rail communication will also help prosperity.

A recent discovery is reported on the claims of the Rouyn Gold Mines, where a vein, said to be 30 ft. wide, has been traced for 1,000 ft. Specimens showing considerable free gold were brought out by airplane in time for the annual meeting.

New Arcadian Progressing With Development Work

The splendid showing in both levels from the New Arcadian shaft of Arcadian Consolidated, in northern Michigan, continues. This is particularly true of the 950-ft. upper level drift, where the rich zone persists. This drift, north toward New Baltic ground, is in more than 1,500 ft., the last half of which has been through vein rock heavily charged with copper. There is considerable mass, and the showing is one which established the shoot as the richest yet encountered.

Good milling ground is being cut in the lower or 1,250-ft. level north drift, which is in more than 800 ft. from the shaft. A good-sized stockpile of stamp rock has accumulated at the mine during the course of development, which, when milled, should return a good profit. Owing to lack of convenient milling facilities, however, no plans have been made for the stamping of this rock.

Production by Utah Mining Camps, Week Ended June 20

Eureka shipped 123 cars of ore during the week ended June 20, compared with 102 cars the week preceding. Shippers were: Chief Consolidated, 47 cars; Tintic Standard, 46; Iron Blossom, 8; Bingham Mines (Eagle & Blue Bell, Victoria, American Star), 7; Dragon, 7; Plutus, 4; Tintic Milling, 3; Centennial-Eureka, 1.

Park City shipped 2,972 tons of ore and concentrates, compared with 3,750 tons the week preceding. Shippers were: Silver King Coalition, 1,685 tons; Park City Mining & Smelting, 589; Park-Utah, 315; Keystone, 403.

"El Rayon" to Operate in Mexico

The "El Rayon" Mining Co. is being organized in Denver for the purpose of operating an exceptionally rich property in the Ocampo region of Chihuahua, Mexico.

The present holdings of the company consist of twelve pertenencias, or the equivalent of about thirty acres, located in the famous Pinos Altos district near Ocampo.

Rich Sapphires Found in Pelmadulla, Ceylon

Recently there has been great excitement over the discovery of a small field of sapphires in the Pelmadulla district, in Ceylon. This place is about 50 miles from Colombo, the chief port, and the field is about two acres in extent. Formerly it was sown for paddy, but in the last year no paddy has been grown, for, instead, there has come up a crop of sapphires, yellow and gold, purple and blue, and weighing anything from 20 to 700 carats. Some of the sapphires found in this field have weighed as much as half a pound, and their value is to be reckoned in thousands. It is a most remarkable find, more wonderful than anything that has been previously reported from Ceylon.

Already the owners of the field estimate they have received at least £60,000 for the sapphires collected, and still there seems to be a large quantity available. A well-known Colombo dealer says "It is a most unprecedented find. They are beyond the dreams of avarice. Hitherto finds of large stones in Ceylon have been rare; but now the fault is on the other side. The stones are mostly too big, and some have been found weighing as much as 700 carats."

The discovery has had an effect on the market, for the Colombo buyers have not the money to purchase all these gems, and so many are there that the demand is less than the supply. Hence it is not easy to get rid of the large stones when purchased. The days of large pendants have gone, also the days when crowned heads were willing to pay £3,000 for a stone. There is little digging to be done, as the sapphires are found from 4 to 15 ft. below the surface.

Much Prospecting in Portland Canal District, B. C.

The Dunwell Mines, Ltd., operating in the Portland Canal district in British Columbia, are proceeding with the driving of a fourth tunnel, and work continues on the north drift of No. 3 tunnel, where a considerable body of high-grade ore is being developed. G. A. Clothier, resident mining engineer, says that the showing is so favorable that a road from the main Bear River road to the mine will be constructed.

The Lakeview mineral claims, situated on Glacier Creek, are to be opened up further this season under the supervision of Richard F. Hill, a mining engineer who has taken over the property. The Silver Crest, about 22 miles from tidewater in the same district, is to be explored by Seymour Campbell, one of the pioneer prospectors of the Portland Canal section.

The Prince John Mining Co. and the M. C. Mining Co. will both operate this season. A London company has taken an option on the old Portland Canal property, and the Portland Tunnels Co. is under option to a British Columbia syndicate. With so many prospects being opened up it is felt that at least one producing mine will be developed in the near future on the Bear River side of the district.

Castle-Trethewey Reserves Expected to Increase

At the Castle-Trethewey property, in Gowganda, the output in May was approximately 150,000 oz. A new vein has recently been found on the 550 level, which shows 2 to 3 in. of 3,000-oz. ore. The company's fiscal year ended on June 30, and it is expected that ore reserves, which a year ago stood at 1,363,000 oz., will show a substantial increase.

Leadore Mines Co. Organized

Organization of the Leadore Mines Co., an Idaho corporation, having two large properties in Lemhi County, has been completed in Coeur d'Alene city with the election of the following officers and directors:

Dr. Oscar Stenberg, president; J. L. Magney, of Spokane, vice-president; E. C. Tousley, secretary, and K. H. Blaesser, treasurer.

It is estimated by J. L. Magney that 700,000 tons of ore is available for the mill, which has been undergoing overhauling and installation of a flotation plant.

Only 40 per cent of the values were recovered by early operators in milling the ores. Recent tests have demonstrated that high recovery can be made with the addition of flotation machines, and a Fahrenwald machine has been ordered to supplement the machinery installed.

Mother Lode Showing More Activity

At the Finnegan mine, near Carson Hill, in the Mother Lode region of California, a third shift has been put to work. The Tullock mine, also close to Carson Hill, has been reopened after a long period of idleness. At Carson Hill an additional shift has been put on diamond-drill exploration. A prospect shaft is being sunk upon the Patterson mine, near Tuttletown.

A discovery of good-grade ore has been reported on the 600-ft. level of the Clio mine. It is expected that the new cyanide plant under construction at the Clio will be completed in June and the milling plant will then be operated upon a three-shift basis. At Drytown, the preliminary work to reopen the Oliver and Drytown Consolidated shafts is being rushed to completion.

Queensland Sapphires Sold

The Queensland Minister of Mines has sold in London £15,000 worth of the sapphires on which the government had advanced £30,000 to the men who mined them, this latter sum being 95 per cent of the estimated value of the gems. He also has an offer from a European firm to take a monopoly of the purchase of all the sapphires from the Anakie field for a term of years, but upon certain conditions as to grading. This monopoly and these conditions the miners are by no means inclined to accept, and yet another attempt to satisfy these miners in the marketing of their gems seems to be on the eve of failure.

Western Mines Consolidated Incorporates

The merger of Nevada City mines, including the Champion, Providence, Home, Pittsburg, and other properties in the Nevada City district, in California, has been incorporated as the Western Mines Consolidated Corporation. Incorporation papers were filed at Carson City, Nev., on June 14, 1924. The capital stock is stated to be 5,000,000 shares at a par value of one dollar per share.

The area of the mining properties aggregates about 3,000 acres. It is said that A. D. Foote, who has served for a number of years as consulting engineer of the North Star Mines and has been in gold-mining activities since 1874, will be president and consulting engineer for the company. C. H. Geldert, of Los Angeles, will be vice-president and Louis R. Ball, of Pasadena, secretary, treasurer, and general manager. The officers will serve as the board of directors. The principal office of the company is to be in Reno, Nev.

Whitewater Mines To Start Developing Holdings

Whitewater Mines, Ltd., which was incorporated in the summer of 1922 to take over the Whitewater and Whitewater Deep mines, in the Ainsworth division of British Columbia, now has an exceedingly strong directorate of practical engineers, and will start an active campaign of development. Major General J. W. Stewart, head of the Northern Construction Co., is president; J. L. Retallack, former principal owner and operator of the mines, is vice-president; and W. H. Burgess, who has been associated with many important mines in West Kootenay, is managing director. R. H. Steward, formerly manager for the Consolidated Mining & Smelting Co., is consulting engineer.

Nearly $2,000,000 of silver-lead and silver-zinc ore has been taken from the Whitewater mine, and a long tunnel has demonstrated the extension of milling ore to a depth of 2,000 ft. in Whitewater Deep mine. The mine is equipped with a good water-power plant and mining machinery. The mill was burned in 1910, and as soon as sufficient ore has been blocked out to determine the capacity required, a new mill will be erected. The old mill was of the gravity type, and had a capacity of 100 tons.

Chief Consolidated Mill Erection Progressing

The Chief Consolidated, of Eureka, Utah, is making good progress in the construction of the mill which it is building to treat its low-grade ores. A suitable process was developed in an experimental plant by the company, and it is expected to begin work some time in August.

The largest buildings were finished some time ago, and the smaller ones are approaching completion. The greater part of the heavy machinery is in place and motors and other electrical equipment are being installed.

Michigan Copper Output 10,580,000 Lb. in June

Refined copper production in the Michigan district in June was estimated to be 10,580,000 lb. Calumet & Hecla Consolidated produced 5,480,000 lb., made up of 2,400,000 from the conglomerate branch, 1,780,000 lb. from the Ahmeek mine, and 1,300,000 lb. from the reclamation plant. This company is operating five days a week. Copper Range produced 2,100,000 lb.; Mohawk, including Wolverine, 1,300,000; Quincy, 1,000,000; and Isle Royale, 700,000.

East Butte-Davis-Daly Suit Transferred to Federal Court

A suit for alleged breach of contract involving $500,000 damages, brought by the East Butte Copper Mining Co. against the Davis-Daly Copper Co. of Boston, has been transferred from the State Court to the United States Court.

It is alleged in the suit that an agreement for the delivery of all copper ore produced by the Davis-Daly company to the East Butte was made on Jan. 20, 1923, to continue in force for five years. On March 1, 1924, it is alleged, the "defendant breached the ageeement in that it failed to sell and deliver to the plaintiff all copper ore produced by the shipper during the life of the contract; it failed to make shipments to the plaintiff as reasonably regular and uniform in quality and quantity as the ordinary exigencies of mining operations permitted." It is also alleged that the contract was breached further by the failure of the defendant company to make shipments under the terms of the contract, in substantial amounts, and that the defendant company wholly refused and failed without cause to keep and perform the terms of the contract.

The defendant company filed a petition for the removal of the case to the United States District Court, citing that the parties were citizens of different states and that the cause of action was for more than $3,000.

Menago Making Progress

Two new oreshoots have recently been opened up on the 1,020 level of the Menago mine, at Cobalt, Ont., and both show high-grade ore. Recent stoping results have also given more satisfactory returns, and the company is now making a fair profit from mill ore alone, about 1,500 tons a month being shipped to the Mining Corporation concentrator.

High-grade Sylvanite Found Near Idaho Springs

What seems to be one of the most important strikes made in the vicinity of Idaho Springs, Colo., for several years was the recent discovery of high-grade sylvanite ore on the Perry group, property recently acquired by the Elmwood Leasing Co., and situated about one mile from the camp. The claims were located in 1923. The sylvanite streak is about two inches wide, and specimens from it give good values.

Consolidated M. & S. Sued by French Complex Ore Reduction Co.

THE French Complex Ore Reduction Co., of Canada, Ltd., has entered suit against the Consolidated Mining & Smelting Co. of Canada for $8,000,000 damages for infringement of patents held by the French company in certain processes connected with the treatment of zinc and manganese sulphate solutions obtained in the hydro-metallurgical workings of zinc-lead ores containing manganese, according to reports from Nelson, B. C.

The French company claims that the inventor transferred his patents to the company in October, 1912, since which time the defendant company has caused the plaintiff damages to the extent of the amount demanded. The plaintiff further asks for a restraining injunction and for cost of the action. The plaintiff also claims that the outcome of the suit will affect the Anaconda Copper Mining Co. of Butte, as it alleges that the last-named company has carried on similar infringement of the French company's patents.

Victory Gold Mines Acquires Plant

The Victory Gold Mines Co., which has opened up a gold property near Aetna Mills, Siskiyou County, Calif., has purchased the mill, mine, and power equipment of the Mountain King Mining Co., which operated the Mountain King mine, at Mountain King, Mariposa County, Calif., for a number of years. The equipment includes a hoist, a trolley locomotive, 20-stamp mill, compressors, and a 400-hp. hydro-electric plant.

The contract for dismantling the plant and removing it to Aetna Mills has been awarded to C. W. King, of San Francisco. The Mountain King mine was shut down several years ago and has since been idle. The Victory mine has been developed persistently, and it is rumored that ore of excellent grade has been blocked out in the mine workings.

Large Deposit of Bauxite Discovered in India

The mineral deposits in India have scarcely yet been touched. There has been discovered in the native State of Kolhapur, a large deposit of bauxite which is probably one of the most extensive in the world. As there is also a large supply of water power in the vicinity of these fields it is expected that in a short time there will be a great development.

Recently the Geological Survey department of India sent an officer to investigate the Kolhapur field, and he declares that a good part of the deposit contains over 50 per cent aluminum oxide. The analysis of two sections gives 59.35 per cent aluminum oxide in the one and 62.32 in the other. It can be safely assumed that not less than 30,000,000 tons of bauxite can be produced at a reasonable cost in this region of India.

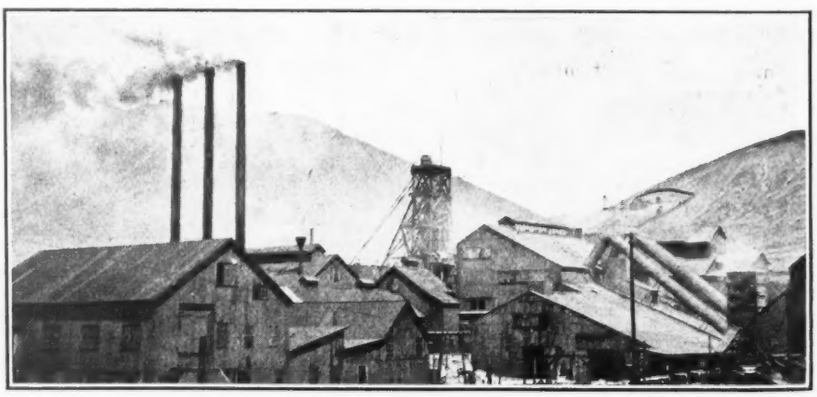
Record Order for Magnetic Equipment

Recently an order from the Chateaugay Ore & Iron Co., Lyon Mountain, N. Y., was placed with the Magnetic Manufacturing Co., for six 30 in. diameter by 36 in. face patented "high-duty" ventilating-type magnetic pulleys and thirty 30 by 30 in. drum-type magnetic separators. This order is thought to be the largest ever placed at one time in this country for magnetic equipment, and is to be used in a new concentrating mill that will produce a 65 per cent iron ore at Lyon Mountain. When built, it will be the finest concentrator in the country, and incidentally will produce one of the best quality iron ores.

Eagle Shawmut Sinking Winze

Sinking is in progress at the Eagle Shawmut mine at Shawmut, Calif. A winze north of the working shaft is being sunk below the bottom level, which is 2,750 ft. in depth measured on the incline of the shaft. The winze has attained a depth of 150 ft., and is to be extended 800 ft. or more below the level. Its purpose is to prospect and develop the present oreshoot.

About 6,000 tons of ore is being mined and milled and 350 tons of concentrates is being shipped per month.



Surface plant of East Butte Copper Mining Co., showing mill, headframe and smelter

New Mineral Division in Commerce Department Established

Guy C. Riddell, of New York, Named as Chief—Broad and Useful Service to Metals and Minerals Industries Forecast

Secretary Hoover has announced the appointment of Guy C. Riddell, of Rye, N. Y., a consulting engineer, as chief of the newly created Minerals Division of the Bureau of Foreign and Domestic Commerce. This new division will involve the consolidation of the present petroleum division with the non-ferrous metals section of the Iron and Steel Division.

Graduated from the Massachusetts Institute of Technology in 1904, Mr. Riddell's wide experience has been gained during many years of activity in the minerals industries. As superintendent of the East Helena Smelter, Mr. Riddell served with the A. S. & R. Co. for 12 years. For two years during the reorganization and modernization of plants and processes of the Australian lead and zinc industry, undertaken by the Broken Hill Associated Smelters in 1912, Mr. Riddell was engaged in the direction of the work. As metallurgical advisor to the U. S. Tariff Commission, he directed preparation of about 100 industrial surveys and conducted investigations into the metal and mining manufacturing industries of the United States. Practical experience in the export field of mineral and metal commodities was gained as general manager of a New York import and export house engaged in the shipment of machinery, metals, ores, and chemicals, to the Far East, and as one of the incorporators of the first American corporation formed under the China Trade Act.

It is the hope of Secretary Hoover that this new division will develop a broad and useful service to the metal and minerals industry of the United States.

Changes in Anaconda's Engineering Department

Lee Hayes, chief mining engineer, and his assistant, C. H. Page, who have been in the employ of the Anaconda company in the Butte office for many years, have retired. The mining engineering department has been consolidated with the geological department, under R. H. Sales as chief geologist and mining engineer; F. A. Linforth is assistant chief geologist and assistant chief mining engineer; F. L. Fisher has been put in charge of the engineering office in the Hennessy Building as assistant chief mining engineer, and William A. O'Kelly in charge of the Hill engineering office as assistant chief mining engineer.

La Catolica Building Small Mill

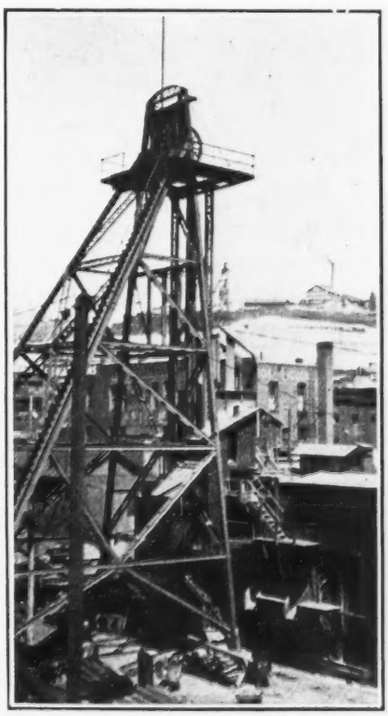
Charles C. McGinnis is installing a Straub mill on the La Catolica property, in the municipality of Choix, Sinaloa, Mexico. A small plant will be built to test the ore. It will be gasoline driven and rely upon amalgamation and concentration to recover the metallic contents of the ore.

Copper Queen Picnickers Make Merry

COPPER Queen employees always look forward to the annual picnic, an event that this company has observed for many years. This property, which is operated by the Phelps Dodge corporation, at Bisbee, is one of the oldest mines in Arizona, and probably does more welfare work for its men than any other. This year the picnic was held at Lewis Springs, and a special train was operated for the employees and their families. Barbecued meat was supplied, refreshments were furnished, and many sports were indulged in by the employees and their families. The baseball battle was between the "Surface" and "Underground" mines. The Copper Queen orchestra provided music. The Sacramento division employees battled against the Lowell workers in the tug of war, and the Southwest section miners "tugged" the winners. There are not many mines with a "family" like the Copper Queen and few parties of this kind are held for employees.

Jib Enlarging Mill

The Jib Consolidated Mining Co., of Basin, Mont., is installing machinery that will make it possible for the company to increase its present tonnage of 300 tons per day to at least 400 tons. The new program of mining and milling the larger tonnage will be adopted as soon as the construction work is finished.



Colorado shaft of Davis-Daly Copper Co. It is in the heart of the city of Butte, Mont. Sorting plant at the right.

New Awards to War Minerals Producers

Removal of the limitation in the original law fixing the total amount to be paid by the government of war minerals claims at the recent session of Congress conveyed the necessary authority to make settlements. The claimants and amounts awarded follow by states:

Arizona

William Blackburn, Courtland, $1,184.72.
Marquette Leasing Company, Bisbee, $992.45.
G. W. Vanderwalker, Patagonia, $2,431.62.
Wittig & Crouch, Bisbee, $924.30.
F. A. Chamberlin, Florence, $1,449.27.

Arkansas

E. B. Griswold, Cotter, $218.40.

California

J. H. Nodine, Atolia, $270.
Creath & Jarvis, Atascadero, $318.65.
B. LeMohn, Venice, $107.40.
W. H. Cox, Yankee Hill, $615.
Sullivan & Conser, Fort Jones, $661.
John F. Hafner, Gazelle, $370.20.
A. F. Benton, San Jose, $1,475.62.
W. W. Gibbons, Hanford, $476.
Andrew Turner, Folsom, $899.24.
J. C. Raynor, Atolia, $1,776.83.
Bulkeley Wells, San Francisco, $6,016.55.
A. H. Laton, Berkeley, $589.18.
William H. Graves, Oroville, $397.39.
West, Ross & Bill, Towle, $208.
Dale Brothers, Sacramento, $520.
C. E. Macy, Iowa Hill, $244.
L. R. Stokes, Yankee Hill, $250.30.
Daisy Chrome Co., Coalinga, $6,792.13.
E. W. Madden, Auburn, $2,050.
E. G. Lewis, Atascadero, $5,916.71.
Rowe, Crain & Malone, Stent, $1,514.
H. H. Crain, Stent, $347.
United States Manganese Mining Co., Hollywood, $5,983.09.
S. A. Goldtree, San Francisco, $2,230.
H. Eckel, Springfield, $383.50.
Clark & Clark, Yonkers Hill, $1,002.50.
F. Anderson, Coyote, $411.
P. S. Dean, Felix, $2,618.30.
W. P. Johnson, Fort Jones, $186.50.
L. C. Morgan & Co., Fortuna, $3,059.92.
M. F. Hopkins, San Jose, $4,095.21.
Lee Payton, Pine Grove, $280.
Gallagher & Grasselly, Tuolumne, $805.
C. E. Jones, Gottville, $750.
E. T. Ellis, Livermore, $681.
Munitions Metals Co., San Francisco, $1,239.76.
Gaylord & Landis, Auburn, $940.06.
Finch & Threlkel, Newcastle, $495.33.
Bingham & Hayden, Callahan, $147.90.
Manganese Development Co., San Francisco, $280.87.
Chastain Brothers, Gazelle, $516.70.
Curley Mining Company, Blythe, $2,583.36.
Bateman & Ramey, Bakersfield, $1,250.
Eleanor Hoeft, Nevada City, $1,819.65.
J. D. Whitney, San Francisco, $146.04.

Colorado

T. T. Wood, Boulder, $1,314.30.
Sullivan & Sullivan, Eldorado, $1,912.95.
Down Town Mines Co., Leadville, $4,626.
E. K. Henderson, Netherland, $1,832.35.
R. E. Keller, Jamestown, $2,425.12.
J. T. Duncan, Boulder, $8,609.05.
Boulderado M. & M. Co., Denver, $9,600.30.

Illinois

Philipsburg-Chicago Manganese Syndicate, Chicago, $210.12.

Nevada

I. N. Gaillac, Goldfield, $190.
Nell, Washburne & Fritz, Imlay, $996.90.
A. R. Shepherd, Ely, $183.27.

New Mexico

J. L. Hougland *et al.*, Deming, $891.
Frank D. Rivera, Derry, $1,372.54.
Silver City Manganese & Development Co., Silver City, $1,206.24.

North Carolina

E. H. Mortimer, Elk Park, $242.26.

Oregon

McCorkle & Andrus, Canyon City, $420.

Pennsylvania

Manganese Products Co., Philadelphia, $15,442.51.

(Continued on page 28)

(War Mineral Awards, Continued)

South Dakota

M. Brosnahan, Deadwood, $321.71.

Tennessee

H. V. Maxwell, Hampton, $1,459.88.
W. H. Kemler, Johnson City, $401.05.

Texas

Kraft & Madero, El Paso, $1,589.25.
Barney Silva, El Paso, $1,720.05.

Utah

Western Utah Copper Co., Salt Lake City, $5,229.69.

Washington

Western Minerals Co., Seattle, $2,131.17.

Wright-Hargreaves Makes a Rich Strike

One of the richest discoveries in the Kirkland Lake gold field, in Ontario, has been made at the Wright-Hargreaves, where a crosscut to the north of the former main workings has disclosed a deposit with high gold content. It has been drifted on for 80 ft., and assay sheets show the development ore to carry about $100 to the ton across the width of the drift, with the faces to the east and west showing gold values well over $100 to the ton.

The new vein, where tapped at the 1,000 level, is identical with the No. 2 vein of the adjoining Lake Shore. The occurrence of this vein on the surface has been known since the mine was opened, but no attempt had heretofore been made to explore it. Important factors in connection with this discovery are that the vein is probably the easterly continuation of the rich Lake Shore vein No. 2, and that the fracture is in evidence all the way across the Wright-Hargreaves and Sylvanite and may extend into the Tough Oakes.

Approximately 6,000 ft. of the fracture lies on Wright-Hargreaves and Sylvanite, about 3,000 ft. on each.

Promising Strike Made Near Lake City, Colo.

A very important strike in the old Golden Fleece mine, about three miles from Lake City, Colo., is announced by Robert Innes, State Mine Inspector. The property was taken over about eighteen months ago by the San Cristobal Mining Co., and the manager, E. P. Simpson, has been directing efforts toward the rediscovery of an old vein famous for its production of rich ore in early days.

The discovery is supposed to be a continuance of the lost Golden Fleece vein. Mr. Innes reports that the oreshoot is about 2½ ft. wide, and development work to date discloses more than a carload of ore which would run upward of $1,000 a ton.

Rochester Leasers Active

Production by the Rochester Silver Corporation, being operated by lessees, for the month of May was 2,994 tons of ore, with a gross value of $32,531.23. Profits realized by the company were $6,760.56 for the month. Mine conditions are said to be excellent, with more than ordinary amount of ore in reserve. It is possible that power shortage will interfere with July and August production, as water supply at the Lahontan power plant of the Nevada Valleys Power Co., is very low.

Mohawk Installing Regrinding Units

AN IMPORTANT saving will be effected by the Mohawk Mining Co., in the Michigan copper district, with the installation of regrinding units for each of the four heads in its stamp mill. One unit has been completed and is being tested. The other three heads, it is expected, will be equipped this year. The work of installation is proceeding without interference with stamping and is being done by the company's own men.

Mohawk, it is estimated, will recover 1.5 lb. of copper per ton in the regrinding of the tailings or waste sand from the stamp heads.

Dease River District Attracting Machinery

The Pendleton Gold Mining Co. is freighting 45 tons of machinery, including a Sauerman drag-line scraper, to its property on McDame's Creek, a tributary of Dease River, Atlin division, British Columbia. The Dickinson Mining Co., of Seattle, also is taking a drag-line scraper to Dease River.

Dease River has long been known to contain rich placer ground, but its inaccessibility has deterred large-scale operations up to now.

Iron King to Sink New Shaft

At the Iron King of Eureka, Utah, a contract has been let for a new shaft which will be sunk to the 1,100 level. At the same time the old shaft is being in part retimbered. Mining, suspended during the latter work, will be resumed when this is completed. Various ore showings will be developed, and exploration work continued.

A road and water line to the site of the new shaft have been completed, and foundations will be started in the near future. An electrical hoist and other equipment have been secured from the Gold Chain mine at Mammoth.

Gold Pen Strikes High Grade

A new high-grade gold strike is reported in the Gold Pen mine. This mine is in the same district as the Nevada Rand and is about 12 miles from the old camp of Rawhide, Nev.

The Gold Pen mine has produced several cars of very high-grade gold ore, some of which averaged several hundred dollars a ton, but the oreshoots so far discovered have proved to be small. The new strike was made by the owners while doing assessment work, and indications are that this year's assessment work will prove to be very profitable.

Lode Prospecting in Goldbasin District Attempted

A large group of claims in the Goldbasin district, 50 miles east of Fallon, Nev., has been optioned by a California syndicate, and reports indicate early starting of development work. Contracts have been let for two shafts to be sunk to a depth of 100 ft., and deeper if conditions at that depth are as encouraging as at present at a depth of 20 ft.

The Goldbasin district has been extensively prospected for placer gold during the last few years, but this work is the first actual lode prospecting to be attempted.

Candelariá in Mexico to Lease Property

Official announcement was recently made in El Paso, that E. D. Morgan, of New York, vice-president of the Candelaria Mining Co., has athoriuzed W. W. Turney, an El Paso attorney, and E. C. Houghton, general manager of the Corralito Cattle Có., as local representatives, to lease to responsible persons any of the company's mining properties in San Pedro district, Chihuahua, Mexico, 112 miles southwest of El Paso.

Tonopah Begins Development Work at Hamilton

The Tonopah Mining Co. has completed installation of compressor and other machinery at Hamilton, Nev., and has started development work. This company has an option on a large area in what was the most productive portion of this bonanza silver ore district, and its engineers believe that faulted segments of the rich orebodies will be found which escaped the original early day operators.

Many Divide companies with substantial treasuries have acquired ground in the district and are making preparations for starting development work on their ground.

Trail Smelter Receipts

Following is a statement of ore received at the Trail smelter for the period June 8 to 21, inclusive:

Name of Mine	Locality		Tons
Cork Province	Zwicky,	B. C.	88
Quilp	Republic,	Wash.	34
Roseberry Surprise, zinc	New Denver,	B. C.	90
Roseberry Surprise, lead	New Denver,	B. C.	75
Silversmith	Sandon,	B. C.	152
Van Roi	Silverton,	B. C.	91
Anna group	Slocan City,	B. C.	6
I. X. L.	Rossland,	B. C.	46
Knobhill	Republic,	Wash.	283
Lone Pine Surprise Last Chance	Republic,	Wash.	169
Republic	Republic,	Wash.	51
Sally	Beaverdell,	B. C.	42
Silversmith lead	Sandon,	B. C.	60
Silversmith zinc	Sandon,	B. C.	99
Company mines	Sandon,	B. C.	19,937
Total			21,530

Jib Extension Incorporates

Articles of incorporation of the Jib Consolidated Extension Mining Co. were filed in the office of the clerk and recorder, at Butte Mont., on June 18. The directors named are Carl S. Trauerman, O. H. Schoch, Ernest Dorais, J. Ross Gavin, and Geraldine Ross.

The office of the company is to be in Butte, Mont. Its mining property is in the Basin district near the Jib Consolidated's operating mine.

London Letter

By W. A. Doman
Special Correspondent

West African Mining Interest Awakening—Russian Agreement Needed

London, June 17, 1924.—Attempts are being made to reawaken interest in gold mining in West Africa. Since the Consolidated Gold Fields of South Africa turned down what was developing into an industry some years ago, the country has been discredited, though there have all along been some producing companies. At one time Prestea Block A was looked upon as a coming big mine, but extraction was interfered with by the presence of graphite. The position of the company went from bad to worse, and it is now proposed to reconstruct it. There seem, however, good grounds for so doing, as development work has disclosed fairly high values. "Very satisfactory results" they are called officially, but it cannot be ignored that working costs are high, though perhaps not too high where such a climate is concerned, though the margin between costs and assay value is not great. The former are estimated at 30s. per ton, dealing with 12,000 tons monthly. Two shafts are apparently down to the 15th level, the total length driven in the 14th level at a depth of 1,799 ft. on the incline being 1,010 ft. assaying 31.5s. over 139 in. On the 15th level at a depth of 1,949 ft. 760 ft. has been driven, assaying 52.6s. over 127 in. It is now proposed to sink the north and intermediate shafts to connect on the 17th level.

The Taquah and Abosso mines, also in West Africa, are likewise showing up in a rather more encouraging manner, and in addition to these two mines the company has acquired the Adjah Bippo mine and the Taquah Central mines. The most encouraging point is that both width and value in the lower levels are good. The trouble in connection with this group of mines is that of labor, a matter which at the moment seems to present a better aspect.

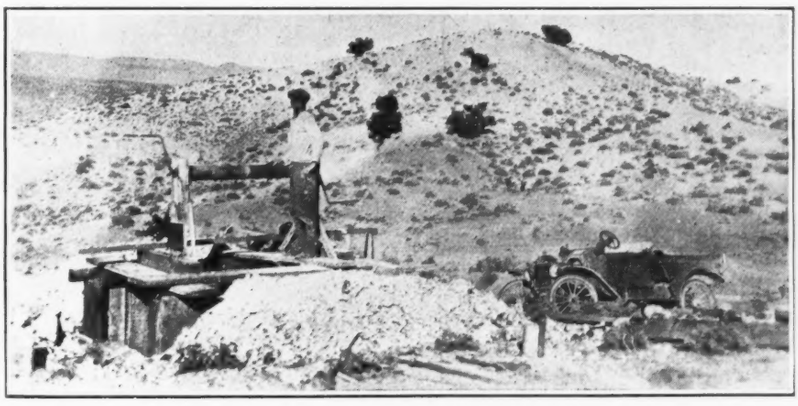
Keno Hill to Have a 100-ton Mill

P. R. BRADLEY, consulting engineer for the Treadwell-Yukon Mining Co., has announced that the company has ordered a 100-ton mill, which will be shipped to Keno Hill, in the Yukon, during this summer and will be erected during next winter. Mr. Bradley stated that since the cutting of the extension of the ore at depth in the long tunnel ample ore has been proved to warrant the erection of the mill. The camp has been renamed Wernecke, after the engineer in charge of operations.

I learn from a usually well-informed source that though the general mission of the Soviet Government to this country may possibly prove to be a failure, there is much hope that the delegates will make some amicable arrangement in regard to claims which different companies and individuals have against the Soviet Government. There seems to be little doubt from the nature of the discussions that the delegates are anxious to revivify the activities of the country, and mining is one of the main factors in their program. It is firmly believed now that if an arrangement is made with owners of mining properties, this arrangement will be kept by the Bolsheviks to the letter, and that they will expect the foreign corporations to be equally scrupulous. There appears to be, therefore, some hope for the great Russo-Asiatic Consolidated.

Zinc Concentrates Purchased by British

The interesting statement has been made in the House of Commons that 1,298,489 tons of zinc concentrates has been delivered to the British Government under the contract with the Zinc Producers' Association Proprietary, Ltd. It will be remembered that the British Government undertook to purchase the output of the Australian mines for the period of the war and ten years thereafter, at something like the market price.



Steve Clark sinks a one-man prospecting shaft in the Hannipah district, 20 miles east of Tonopah, Nev.

Johannesburg Letter

By John Watson
Special Correspondent

Rand Gold Companies Having Labor Troubles

Johannesburg, May 19, 1924 — The following are the results of crushings for the month of April of the twelve leading profit-earning gold mines:

	Tons Crushed	Value or Revenues	Cost per Ton Milled		Estimated Profit
		£	s	d	£
Government Areas	146,500	300,349	18	7.3	167,277
New Modder	111,000	250,021	17	9.9	151,099
Crown Mines	203,000	290,378	20	2.1	85,600
Van Ryn Deep	63,600	136,369	19	10.6	74,087
Modder Deep	42,700	105,961	16	5.0	70,920
Randfontein Central	196,000	260,625	19	10.2	67,532
City Deep	93,000	172,840	23	2.8	65,003
Springs	63,000	121,500	22	0.8	61,108
Modder B	63,000	121,377	19	10.3	58,832
Brakpan	70,000	117,228	21	1.5	52,074
Geduld	67,000	109,067	18	11.0	45,652
Robinson Deep	69,000	.....	18	8.0	45,157

The Transvaal gold output for April was declared on May 10 as 768,923 fine ounces, having a realized value of £3,604,326. Good Friday being a holiday on the mines, April had only twenty-five working days, whereas March had twenty-six. The above figures show a decrease in quantity of 25,759 fine ounces, compared with March, and the decrease in value is equal to £204,949. Gold in April realized 2s. per fine ounce less than the March price. The daily average for April was 154 oz. better than in March.

Among the most notable increases, the Witwatersrand mine had 2,072 fine ounces and New State Areas showed an increase of 1,595 fine ounces over the March figures. The native labor returns show 3,461 fewer "boys" on the gold mines at the end of April, compared with the end of March. Speaking in Johannesburg, on May 13, General Smuts was reported to have said that in 1922 the mines made a promise to him, that if there were a proper settlement made, if the low-grade mines were given a chance and could continue, although a large number of white miners would be displaced at the moment, with confidence, with settled conditions, and with efficiency there would be such further development on the Witwatersrand that every man displaced would be taken into employment again, and there would be more places than men coming forward to fill them. That was the promise to him, said General Smuts, and he would hold the mines to that promise. The president of the Chamber of Mines (Sir Evelyn Wallers) has issued a statement denying in the most definite manner that any such promise was given.

Owing solely to the action of the government in restricting the supply of Portuguese labor, the industry has been unable to maintain a continuously adequate native labor supply. Over two million pounds of new money, the provision of which has only been rendered possible by the improved economic conditions, has been subscribed for West Springs, New State Areas, Robinson Deep, Durban Deep, Simmer & Jack, Modder East, Springs, and Brakpan.

Societies, Addresses, and Reports

Columbia Modifies Entrance Requirements

Also Offers New Courses in Mining and Metallurgy

The Faculty of Applied Science of Columbia University, having in charge the Schools of Mines, Engineering, and Chemistry, has introduced important new courses into the program of study. Co-operation has also been brought about with the National Institute of Public Administration, formerly the Bureau of Mining Research.

In metallurgy, a new program of study is offered for the student who expects to obtain an expert knowledge of the physical properties of metals as related to other uses and the methods of testing them. The student who completes this course will look forward to becoming a metallurgist connected with a manufacturing establishment rather than becoming a metallurgist engaged in the extraction of metals from their ores.

In mining, besides the standard courses, options are offered in mining geology and in ore dressing.

Columbia has also modified the admission requirements to the engineering schools, which provide that a student entering Columbia College with a good scientific preparation may, in a prescribed course, be prepared for admission to the engineering schools in two years and one summer session.

Indian University to Teach Mining and Metallurgy

Considerable interest has recently been aroused in the progress of technical education in India, according to a recent report from Donald Renshaw, Assistant Trade Commissioner at Calcutta. A new development is the inclusion in the curriculum of the Benares Hindu University of courses leading to the Bachelor of Science degree in mining and metallurgy. The mining course will devote particular attention to coal mines, and iron and steel will be specially emphasized in the metallurgy course.

The usefulness of this additional technical school becomes apparent when it is remembered that the annual mineral production of India now exceeds 320,000,000 rupees in value, giving daily employment to 350,000 persons.

Oil-field Engineering Course Will Start in September

A course for the training of oil-field engineers, recently provided for by the board of regents of the University of Oklahoma, will start in September, under the direction of H. C. George. Decision to establish it was reached in 1923, when C. J. Wrightsman, of Tulsa, and Frank Buttram, of Oklahoma City, were appointed members of the board of regents. Need for trained men in oil-field managers and engineers in the Oklahoma oil field is said to be the cause of the move to found the new school.

Golden School Testing Plant to Run During Summer

The metallurgical ore-testing plant of the Colorado School of Mines will operate during the summer vacation, and will continue investigations regarding treatment of complex ores, which is being conducted on an extensive scale jointly with the mine operators. Considerable new equipment has been installed and under the direction of Professor Weinig the testing plant has become an important factor in helping solve the problems of Colorado millmen.

Explosives Men Talk to San Francisco A.I.M.E.

Recently the San Francisco section of the A.I.M.E. was addressed by J. C. Costello, of the Giant Powder Co., on the subject of the use and abuse of explosives. Grant H. Tod, of the Coast Manufacturing & Supply Co., discussed fuse, and E. L. Watts, of the California Cap Co., concluded the meeting by an address on the application of electricity to blasting. Mr. Costello said that the selection of proper grades of explosives that would be suitable and economical, the proper handling and storage, and the practical methods required in their use, were subjects upon which the powder-manufacturing companies are seeking to inform users of explosives. He advocated greater managerial supervision of blasting operations in mines. In addition, he stated that the engineer was an essential factor in directing the use of explosives, for without his aid efficiency based solely upon the efforts of the manufacturers' service men could not be obtained.

Mr. Tod, after reviewing the history of safety fuse, said that before the proper kind of fuse can be selected it is necessary to know the type of drill used in a mine, whether the mine water is acid or not, and whether natural or forced ventilation is in use. Proper storage of fuse was necessary to insure an even rate of burning. Dampness is to be avoided. A test for a magazine in which fuse is to be stored is to place an open salt shaker in the magazine, and if after an interval of seventy-two hours, the salt can be freely discharged through the shaker, the degree of dampness indicated will not be harmful.

Fuse should be cut and capped by one man at the surface and blasting caps must be pressed lightly on the fuse ends, so that the fulminating mixture is in contact with the fuse before crimping.

Increase of pressure, Mr. Tod said, accelerates the rate of burning of fuse. Excessive tamping may result in lifters exploding before the cut holes in a round. The return of an air wave after several blasts have occurred may drive water into cartridges and the fuse itself. This susceptibility to pressure is the cause of many cases of uneven burning of fuses. Mr. Tod described the Cordeau Bickford fuse and demonstrated the method of connecting up a group of blasts.

Mackay School of Mines Receives Additional Endowment

To Continue for Five Years — New Building for Physics, Chemistry and Mathematics

President Walter E. Clark announced at the commencement exercises of the University of Nevada, held recently, that Clarence H. Mackay had given an additional annual endowment of $18,000 for five years to the Mackay School of Mines. The school is now receiving an annual endowment of $6,000, which was given by Mr. Mackay in 1912. The conditions of the recent endowment, which becomes effective Jan. 1, 1925, are that in the event of substantial progress being made in the five-year interval securities amounting to $450,000 will be given to the school and the endowment made permanent. In addition, a new science building to cost $180,000 will be given to the University by Mr. Mackay. This building will provide for the departments of physics, chemistry, and mathematics. In 1908, Mr. Mackay gave the Mackay School of Mines building and campus improvements to the University of Nevada. His benefactions total about $1,000,000. The gifts to the University were made in memory of his father, John William Mackay, who was one of the successful miners of the Comstock.

Heat Transmission Research Will Be Undertaken

The National Research Council through its Division of Engineering has been requested to undertake investigations in heat trasmission, the results of which will provide the designing, operating, and research engineer with reliable information. The Division of Engineering will make a careful digest of the available information on the subject and prepare a critical summary of these data. This summary will serve the twofold purpose of giving the industry a concise statement of the best existing information and enabling the committee to draw up a program of needed investigations.

The problem of heat transmission is so broad and concerns so many fields of engineering—as, for example, refrigerating, heating, electrical, ventilating, automotive, and mechanical—that it is necessary to subdivide the work among suitable subcommittees. The entire project will be administered by a small executive committee with the following officers: W. H. Carrier, chairman; T. S. Taylor, vice-chairman, and H. Harrison, Brunswick-Kroeschell Co., 30 Church St., New York, secretary.

Inventions Exhibit Slated for New York This Fall

Ingenuity of inventors in all fields will be displayed at the exposition of inventions to be held Dec. 8 to 13 inclusive in the Engineering Societies Building, in New York, by the American Institute of the City of New York. The organization will handle this display through its Inventors' Section. It has an experience of ninety-six years behind it in fostering and portraying American industrial life.

Men You Should Know About

Douglas Lay has left Vancouver for London, England.

O. B. Perry, of the Yukon Gold Co., is in San Francisco.

J. H. Veasey, of Johannesburg, South Africa, is in the United States.

John W. Sherwin, general manager of the West End and Halifax companies, recently made a trip to Tonopah.

W. E. Simpson has returned to Swastika, Ontario, after a three months' trip to London and Paris.

Arthur Barneveld Bibbins

Arthur Barneveld Bibbins, geologist, and vice-president of the Lee Mineral Co., of Baltimore, is engaged in an investigation of the potash possibilities of western Texas. By an arrangement with the U. S. Geological Survey, duplicate samples are sent to Washington for assay.

O. H. Fairchild, of Chicago, is in Tokyo, Japan, on professional business. He expects to return to the United States in August.

H. G. Ferguson, of the U. S. Geological Survey, will begin a geological survey of the Alleghany district in California in August.

Gibson Berry, superintendent for the Round Mountain Mining Co., at Round Mountain, Nev., has returned to the mine from San Francisco.

R. L. Agassiz, of Boston, president of Calumet & Hecla Consolidated, is visiting the properties of the company in the Michigan copper district.

Albert Silver, metallurgical engineer of Tonopah, has returned to Tonopah from a professional trip to Chicagoff Island, off the coast of Alaska.

Henry Hanson was recently in Winnipeg, Manitoba, from which city he left for a three weeks' trip to the Bull Dog Lake district near the Ontario boundary.

R. M. Henderson, manager of the Wellington Mines at Breckenridge, has returned to the state from a month's inspection trip to company properties in Nevada.

J. A. P. Gibb, consulting engineer for Anglo-French Exploration, Ltd., has has been making an examination of mining properties in the Gowganda silver area of northern Ontario.

H. C. Carlisle, chief engineer for the Tonopah Mining Co. in its western territory, was recently at Hamilton, Nev., where the company has started development work on the old Treasure Hill mines.

Hugh Rose, manager for the Gold Field American Development Co., in Mexico, which company controls the Comstock Merger Co., has been in Virginia City, Nev., on business for his company.

W. R. Guiberson, vice-president of the Guiberson Corporation, of Los Angeles, Calif., recently visited the Dallas, Tex., office of the company, and will spend several weeks in Texas on business.

John T. Reid has left New York and is at his home in Lovelock, Nev. After completing some professional work there, he will return to New York about the first of November, to remain for several months.

J. B. August Kessler, managing director of the Royal Dutch Petroleum Co., left for the Orient on the "Empress of Canada," which sailed from Vancouver on June 19. He was accompanied by Mrs. Kessler.

Walter Harvey Weed, geologist and publisher, of New York, was in Wallace, Idaho, on July 27 to attend as consulting engineer the annual meeting of the directors of the Callahan Zinc-Lead Co., after which he immediately left for Alaska.

E. N. Rhodes, president of the British America Nickel Corporation, announces that an appeal will be taken against the recent decision of Judge Kelly in favor of M. J. O'Brien, Ltd., in that company's action against the corporation.

Charles McCrea, Ontario Minister of Mines, has returned from a visit to England. He found the financial men of London eager for accurate information as to the opportunities for investment in developing the mineral resources of Ontario, and anticipates that his mission will have substantial results.

Allen H. Rogers has been elected president and **Lucius W. Mayer** vice-president and treasurer of the Swedish American Prospecting Corporation. Rogers, Mayer & Ball will act as consulting engineers, in the conduct of the business of the corporation, which has acquired the sole license under the Lundberg patents, for North, South, and Central America, to carry on electrical surveys for locating ore deposits.

Obituary

Dr. Fred Walter McNair, president of the Michigan College of Mines, educator, engineer, physicist, and writer, was killed in a railroad wreck at Buda, Ill., on June 30, when a mail train of the Chicago, Burlington & Quincy R.R. crashed into the passenger train in which Dr. McNair was returning from Boulder, Colo., where he had been attending a meeting of the Society for the Promotion of Engineering Education, in company with W. E. Wickenden, of New York. Six others lost their lives in the accident, and sixteen were injured. Dr. McNair was a past president of the society, and had taken an active and enthusiastic interest in its object and work. Truly may it be said of him that he died in action, in the service of the profession which he loved and upon which he conferred distinction and honor.

Dr. McNair was born in Fennimore, Wis., on Dec. 3, 1862. He received his B.S. degree from the University of Wisconsin in 1891, was a student at the University of Chicago in the winter of 1893, and was accorded the Sc.D. degree by Lafayette in 1907 and the same honor by Rhode Island State College in 1919. He had been president of the Michigan College of Mines since 1899. In 1886 Dr. McNair was married to Bertha Philbrick. He was a Fellow of the American Association for the Advancement of Science, and a member of the Lake Superior Mining Institute, of the A.I.M.E., and of the American Physics Society. His most recent contribution to *Mining Journal-Press* was an appreciation of William Kelly, on the latter's election as president of the A.I.M.E., which appeared in the Feb. 23 issue of this year.

Dr. McNair's sudden and untimely death will be a shock to all who knew

Dr. Fred Walter McNair

him, and will bring sorrow to the hundreds of men to whom he had been a mentor, a teacher, guide, and friend.

The funeral of Dr. McNair took place at his residence in Houghton, Mich., on Thursday, July 3.

Samuel L. Jones died at Santa Monica, Calif., on June 18, 1924. He was born at Cleveland, Ohio, in 1834, and when a young man engaged in mining in Idaho, British Columbia, and other Western localities. In company with his brother, John P. Jones, later a Senator from Nevada, he went to Virginia City, Nev., in the early days, and in association with others obtained control of the Crown Point and Belcher mines. Soon thereafter bonanza orebodies were discovered and Mr. Jones and his brother became wealthy. His death removes one of the last of the Comstock miners.

Recent Technical Publications

Reviews, Abstracts, and References

California Gold Placers

Gold Placers of California. Bulletin No. 92, California State Mining Bureau, San Francisco. Price $1.50.

This bulletin is by Charles S. Haley and is an optimistic review of the placer-mining possibilities of a state once famous for its rich placers. The following are the chapter titles: Control of Mining Debris; Placer Mining Methods; Placer Resources. In the last chapter the following river systems have been described: Klamath, Trinity, Salmon, Sacramento, Feather, Yuba, Bear, American, Consumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, San Joaquin, Fresno, Kings, Kaweah and Kern. A brief description is given of the Coast Range, Inyo, and Mohave desert placers. The descriptions are more or less in narrative form, and no doubt represent cursory opinion as the result of observation and conference with those familiar with the various localities. Many extracts are given from U. S. Geological folios and publications. Bibliographies are appended to each chapter. A historical compilation of events leading up to the discontinuance of hydraulic mining and the various attempts to revive in some measure the past activities is also included.

The review is interesting, and indicates that there are possibilities of finding deposits that may prove suitable for working under present conditions. In his foreword, Mr. Haley says: "From investigations thus far, it seems fairly safe to assume a total of seven billion yards of gravel distributed among the different drainage areas, as follows, approximately: Feather River, 500,000,000 yards; Yuba River, 3,500,000,000 yards; Bear and American rivers, 2,500,000,000 yards; Mokelumne, Consumnes, Calaveras, Tuolumne, and Stanislaus rivers, 500,000,000 yards. The foregoing figures include both drift and hydraulic ground. The total is of course not all available for working from an economic standpoint. It is fairly safe to assume that at least 40 per cent of this, owing to its location and elevation with regard to available water, is not feasible for working. This leaves, roughly, about 4,000,000,000 yards, which, judging from past performance in the days of unrestricted mining, should yield an average of about 15c. a yard; and if hydraulic mining is restored under proper restrictions with regard to controlling of debris, there is roughly in the neighborhood of $600,000,000 to be recovered from these drainage systems alone."

The foregoing quotation is given because it summarizes Mr. Haley's opinion, which is important if true. However, Mr. Haley does not indicate the method by which he arrived at his estimates, nor does he present accurate evidence of the unit values recovered from hydraulic mining projects in the past. An analysis of a hydraulic mining enterprise on the basis of present economic conditions is lacking and might have been extremely illuminating if presented. The report thus lacks conspicuously any bridging of the gap between past and present conditions. GEORGE J. YOUNG.

A Handbook of Prospecting. By W. L. Goodwin. Industrial and Educational Publishing Co., Gardenvale, Quebec, Canada. Price $3.

Though designed especially for the Canadian prospector, Dr. Goodwin's book contains much that is of general application. The first hundred pages contain descriptions of minerals such as are found in any mineralogy, only boiled down. The next hundred pages apply the same process of condensation to the science of petrology. Then comes 75 pages in which the principal forms of mineral deposits are discussed, Canadian occurrences being here especially stressed. The last thirty pages consist of advice to the prospector regarding what he should know, his equipment, and the way he should conduct himself both before and after making a discovery. The requirements of the Canadian mining laws are here brought out. The book is of handy pocket size with a flexible binding which should not be packed next to food without being deodorized.

Alaska—Bulletin 754 of the U. S. Geological Survey, Washington, D. C., 129 pages, with four large maps, is entitled "The Ruby-Kuskokwim Region, Alaska." It describes the geology of a section of west-central Alaska, in which are included the important Yukon placer districts of Iditarod, Ruby, and Innoko, and the Candle Creek placer district, in the Kuskokwim valley. The authors, J. B. Mertie, Jr., and G. L. Harrington, made the surveys on which this report is based, in 1915. Copies may be obtained free from the Survey as long as its supply lasts; thereafter for 50c. from the Superintendent of Documents, Washington, D. C.

Benjaminite — Bulletin No. 2,537 of the *Proceedings* of the U. S. National Museum, Washington, D. C., 9 pages, is entitled "Benjaminite, a New Sulphosalt Mineral of the Klaprotholite Group" by Earl V. Shannon. This new mineral has been discovered near Round Mountain, Nev., and contains about 51 per cent of bismuth, 25 lead, 16 sulphur, 4½ copper, and 3½ silver.

Magma Smelter—A short description of the new smelter of the Magma Copper Co. at Superior, Ariz., by Joseph Irving and C. F. Willis, appears in the June 15 issue of the *Arizona Mining Journal.* (Phoenix, Ariz.; price 20c.)

Carbonaceous Gold Ore — In the *Bulletin* of the Institution of Mining and Metallurgy for May appears a 5-page paper on "Carbonaceous Matter at Porcupine." J. M. Bell describes its geological occurrence, and André Dorfman discusses the metallurgical steps that have been taken to prevent it from making trouble in cyanidation. The solution of the difficulty consisted in adding about 5 lb. of crude oil per ton of ore, to the pulp in the ball mills. This seems to coat the particles of graphite and prevent them from precipitating the gold from the cyanide solution.

Missouri Mining—The annual report of the Missouri Bureau of Mines, Mining, and Mine Inspection for 1923 has been issued as a 50-page booklet, obtainable from the Bureau at Jefferson City, Mo., on request. Most of the bulletin is devoted to the coal-mining industry of the state, but the operations of the lead and zinc companies are briefly described.

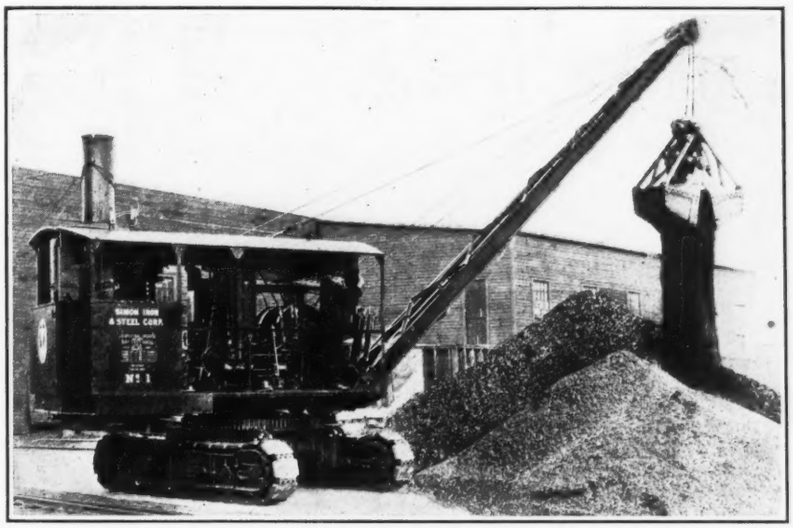
Economic Geology—*Economic Geology* for June-July (Lancaster, Pa.; price 65c.) contains the following articles: "Nickel Ores from Key West Mine, Nevada," by Waldemar Lindgren and W. Myron Davy, 11 pages; "Some Methods for Heavy Mineral Investigations," by R. D. Reed, 18 pages; "Geology of the Beatson Copper Mine, Alaska," by Alan M. Bateman, 31 pages; "A Magmatic Sulphide Ore from Chicagof Island, Alaska," by Paul F. Kerr, 8 pages; and "High Temperature Manganese Veins of the Cuyuna Range," by George A. Thiel, 5 pages.

Gold and Silver—"Gold and Silver in 1922," 40 pages, by J. P. Dunlop, has been issued as a separate paper of the "Mineral Resources" series, by the U. S. Geological Survey, Washington, D. C., from whom it is obtainable on request.

Refractories—The Refractories Manufacturers Association, F. W. Donahoe, secretary, 2,202 Oliver Building, Pittsburgh, Pa., has published a small booklet of 48 pages, giving the names of brands of firebrick and other refractories, together with a list of manufacturers in the United States and Canada. The list is well arranged for handy reference and will be sent free on request to the secretary of the association. This is the fifth edition of this book.

Mining and Quarrying Methods—*Rock Products* has published a series of three articles by J. R. Thoenen entitled "Mining and Quarrying Compared by an Engineer Familiar With Both Operations." These appeared in the issues of April 19, May 17, and June 28, each of which may be obtained from the publishers at Chicago for 25c. The articles are well illustrated, and give one a good practical idea of common mining and quarrying methods.

Nitrate Industry—The U. S. Department of Commerce, Washington, D. C., has issued Trade Information Bulletin No. 240, 41 pages, obtainable on request, entitled "The Air-Nitrogen Processes," by J. M. Braham. This bulletin describes the arc process, the cyanamide process, the direct synthetic ammonia process, and miscellaneous nitrogen-fixing processes, as well as covering the interrelation of nitrogen-fixing processes and products and the growth of the nitrogen-fixation industry. This is part 3 of the Nitrogen Survey; Part 1, "The Cost of Chilean Nitrate," being issued as Trade Information Bulletin No. 170, and Part 2, "General Review of the Nitrogen Situation in the United States," as No. 226.



A new tractor crane for which versatility is claimed

New Machinery and Inventions

New 10-Ton Crawling Tractor Crane Developed

The 10-ton crawling tractor crane illustrated in the accompanying cut has been developed by the Industrial Works, Bay City, Mich., and is known as its type D crane. It has independent control of the traveling, slewing and hoisting motions, so that they may be used in a variety of combinations. There are two traveling speeds, and reversal of direction is accomplished by reversing the engine. Steering while propelling is accomplished from the operator's platform through friction clutches and brakes controlling each tractor belt. Either belt may drive, coast, or be held by brake in any degree to negotiate as sharp or wide a turn as desired.

The crane is built for either steam, electric, or gasoline power. The steam crane has two horizontal, double-acting cylinders 6 in. diameter by 8 in. stroke. The gasoline crane is equipped with either the "Buda," Climax, Wellman-Seaver-Morgan, or Automatic semi-Diesel engine.

The crane operates with clamshell or drag-line bucket, electro-magnet, hook and block, or grapple. It is readily convertible into a shovel or a pile driver.

Agree to Use Each Other's Air-lift Equipment

Users of air-lift water-supply systems should be interested in the recent agreement entered into between the Indiana Pump Co., Indianapolis, Ind., manufacturers of air-lift equipment, and the Chicago Pneumatic Tool Co., New York, builders of air compressors, whereby each organization will use jointly, and exclusively, the products of each other on all their air-lift installations. Thus the great increase in demand for air-lift pumping systems in the United States and Canada will be better served by the engineering staff of both companies, it is stated.

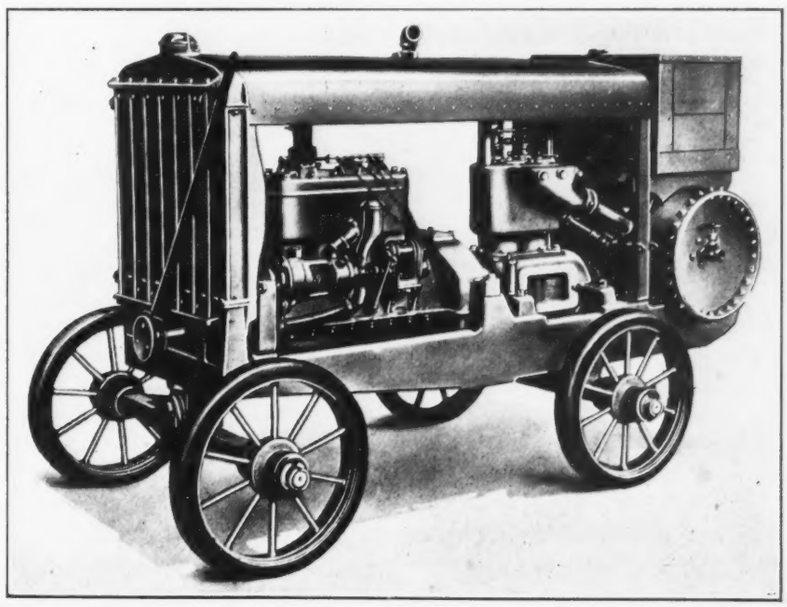
Another Portable Compressor Introduced

A new 100-ft. portable air compressor, driven by gasoline engine, to meet the requirement for a compressed air unit handling one rock drill, has been added to its line by the Chicago Pneumatic Tool Co. It will also operate two concrete busters or two clay diggers; two riveting or calking hammers, or four backfill tampers.

The compressor is of the vertical single-acting duplex type equipped with Simplate inlet and discharge valves. The differential unloader regulates the air supply and the auto-pneumatic throttle provides additional fuel economy by slowing the engine to idling speed during the unloaded periods and speeding it up again just before the load is resumed. Splash lubrication is used.

A flexible coupling, which can be quickly disconnected for starting, when desired, connects the compressor directly to a heavy-duty four-cylinder gasoline engine. Both engine and compressor are thoroughly cooled by a large-capacity radiator, built in sections and protected against damage by seven vertical bars. A cast-steel deck provides a common base for engine, compressor, and air receiver. The gasoline tank is carried in a separate section of the tool box.

The complete unit is supplied in the regular steel-wheel or rubber-tired portable model, the rubber-tired trailer type or mounted on a 1-ton Ford truck chassis.



This compressor will serve one rock drill, or two riveting or calking hammers

Trade Catalogs

Valves. The Merco Nordstrom Valve Co., a subsidiary of the Merrill Co., of San Francisco, has just issued Bulletin 1, describing its Merco Nordstrom plug valves; Bulletin 2 on Merco lubricants; Bulletins 3, 4, and 5, on various types of Merco Nordstrom plug valves; Bulletin 6, on Duriron-Merco lubricated cocks; and Bulletin 7, on Knight-Merco plug valves. These are bound in one cover.

Steam Shovels. Bulletin 314 of the Marion Steam Shovel Co., Marion, Ohio, covers the Marion Model 350 shovel and the Model 360 dragline. The design of electric and steam machines is described and contrasted on opposite pages, and many details of construction and operation are explained at length.

Centrifugal Pumps. Bulletin No. 122, published by the Morris Machine Works, Baldwinsville, N. Y., describes Morris double-suction centrifugal pumps with horizontally split casing. The construction and operating details of these pumps are explained, typical performance curves are given, showing the efficiencies and other characteristics of different sizes under various conditions of operation, and the use of these pumps for various services is outlined.

The Market Report

Daily Prices of Metals

June	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
26	12.05@12.25	43.25	43.75	7.00	6.75	5.80
27	12.125@12.25	43.375	43.875	7.00	6.70	5.80
28	12.20@12.25	43.375	43.875	7.00	6.70	5.80
30	12.25	43.625	44.125	7.00	6.70	5.80
July 1	12.25	44.25	44.75	7.00	6.70	5.80
2	12.25	44.125	44.625	7.00	6.70	5.80
Av.	12.219	43.667	44.167	7.00	6.708	5.80

*These prices correspond to the following quotations for copper delivered: June 26th, 12.30@12.50c.; 27th, 12.375@12.50c.; 28th, 12.45@12.50c.; 30th to July 2d inc., 12.50c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
26	60⅝	61½	65	224½	224⅜	31⅞	29	32	31½
27	61⅛	62¼	65¾	224⅝	224¾	32⅛	29⅝	32¼	31¾
30	61¾	62¾	66	226¼	226½	33⅜	30⅜	32⅛	31¾
July 1	61⅝	62⅝	66	228½	229⅛	32¾	30⅛	32⅛	31⅞
2	61¼	62⅛	65½	228¼	228½	32½	30	32⅛	31⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
26	4.32⅞	66	34 5/16	95s 4d	30	4.32⅛	65¾	34¼	95s 5d
27	4.32¾	66⅛	34⅜	95s 2d	Jul. 1	4.31⅝	65¾	34¼	95s 6d
28	4.32	65¾	34¼	.....	2	4.32¾	66⅛	34⅜	95s 4d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for June

Copper:	
New York Electrolytic	12.327
London Standard	61.375
London Electrolytic	66.313
Lead:	
New York	7.020
St. Louis	6.848
London	32.138
Silver:	
New York	66.690
London	34.758
Sterling Exchange	431.675
Zinc:	
St. Louis	5.792
London	31.788
Tin:	
99 per cent	42.265
Straits	42.765
London	219.219
Quicksilver	73.720
Antimony	8.403
Platinum:	
Refined	116.000
Crude	113.000

Metal Prices Show Little Change in Quiet Market

New York, July 2, 1924—Demand has not amounted to much during the last week for lead, zinc, or tin, but prices have been well maintained, owing to lack of pressure to sell, the dullness at this time of the year being expected. Copper has been in a little better demand, particularly abroad, and prices are now somewhat above the record lows of last week.

Foreign Demand Helps Copper

An occasional order of from 100 to 500 tons of copper was booked during the week for shipment to domestic points, but there was little interest in the market. Monday saw the best business of any day; today there was hardly an inquiry, and it was thought in some quarters, therefore, that the generally quoted price of 12½c. delivered might be shaded, but there is no actual quotational or sales evidence to prove this. Cables received from abroad this morning reported sales of several hundred tons of copper in France and Germany at close to 12⅜c., c.i.f., so it is difficult to see why any producer should be willing to sell below 12½c. delivered, here. English dealers have also supported the market during the week; in fact, were it not for the good volume of orders that have been received from abroad, the present level of prices could hardly have been maintained.

Little Call for 7c. Lead

The official contract price for lead of the American Smelting & Refining Co. continues at 7c., New York. Practically all producers report a marked slackening in demand, but from no source does there appear to be any desire to cut under the 7c. level, which is the price generally quoted for any delivery. Some encouraging orders were recorded during the week from lead pipe and battery manufacturers, but no consumer is showing much disposition to buy much more than is needed for early use. In the Middle West, prices have declined somewhat, it being possible to do 6.70c. in either St. Louis or Chicago since last Friday.

Zinc Holds at 6.80c.

Domestic demand for zinc continues on an extremely limited scale. Export sales have taken the pressure off the market, however, producers being willing to book foreign business, even at slight concessions over domestic asking prices, rather than depress the American market further. With ore prices at present levels it is hardly likely that any producer will be willing to sell below 5¾c. New York prices continue 35c. per 100 lb. above the St. Louis quotation. High-grade zinc, marketed almost entirely on a contract basis, continues to go out at 7¾@8¼c. delivered in the East.

Tin Price Up; Demand Absent

Apparently those in control of tin in London are good waiters, for prices show a tendency to strengthen rather than weaken, while awaiting a resumption of American demand.

Foreign Exchanges Unchanged

But little change occurred in sterling or other exchanges outside of the usual daily fluctuations. On Tuesday, July 1, closing cable quotations on francs were 5.1475c. and lire, 4.30c. Canadian dollars, 1⅛ per cent discount.

Silver Up to 66⅛c.

London orders probably show renewed support from the Continent. The Polish Government has purchased 3,200,000 oz. of silver, as reported in full on page 24 of this issue.

Mexican Silver Dollars—June 26th, 50⅜c.; 27th, 50⅛c.; 28th, 50⅜c.; 30th, 50⅜c.; July 1st, 50⅜c.; 2nd, 50⅞c.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28@29c. per lb.; 98 per cent, 27@28c.

London, 98 per cent, £125 per long ton.

Antimony—Per lb.:
Chinese and Japanese brands, 8⅜@8½c.
W. C. C. brand, 11c.
Cookson's "C" grade, 12⅛c.
Chinese needle, lump, nominal, 8½@9c.
Standard powdered needle, 200 mesh, 9@10c.
White oxide, Chinese, 99 per cent Sb_2O_3, 10@11c.

Bismuth—$2.40@$2.45 per lb. London, 10s.

Cadmium—60c. per lb. London, 2s. 6d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 9s. for black oxide.

Germanium Oxide—25 to 50 gm. lots, $10 per gm.

Iridium—$260@$270 per oz. Nominal.
Iridium alloyed with platinum, $280@$286.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, 90c.@$1 per lb. London quotes 3s. 3d. for 99 per cent.

[1]**Molybdenum**—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—27c. per lb. for 99 per cent virgin metal. London, £135.

Osmiridium—Crude, $58.50 per oz.

Osmium—$95@$104 per troy oz.

Palladium—$78@$83 per oz. Crude, $60 per oz. London, £17.

Platinum—Refined, $116 per oz.
Crude, $112@$114.
London, £27 for manufactured.
Market firm and quiet.

Quicksilver — $73 per 75-lb. flask. San Francisco wires $72. London, £13.

Radium—$70 per mg. radium content.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tantalum—Metal, $400 per kg.

Tellurium—$2 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $8 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

[1]**Zirconium Metal**—98 per cent grade, per lb., $30.

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:
Indian, $19.50.
Rhodesian, $21.50.
New Caledonian, $24.
Market nominal.

[1]**Galena Radio Crystals**—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500 lb. lots, f.o.b. Philadelphia.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports:
Old Range, bessemer, 55 per cent iron, $5.65.
Mesabi, bessemer, 55 per cent iron, $5.40.
Old Range, non-bessemer, 51½ per cent iron, $4.90.
Mesabi, non-bessemer, 51½ per cent iron, $4.75.

Magnetite Ore—F.o.b. Port Henry, N. Y., per long ton:
Old bed, 21 furnace, $5.
Old bed, concentrates, 63 per cent, $5.25.
Harmony, cobbed, 63 per cent, $5.25.
New bed, low-phosphorus, 65 per cent, $7.50.

Manganese Ore — 42@45c. per long ton unit, seaport, plus duty. Nominal. Chemical grades[1], powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, Caucasian, and Javanese, $75@$80 per ton in carloads.

Molybdenum Ore—80c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Pyrite Radio Crystals—(Best quality) $1.50 per lb. in 500-lb. lots.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $9@$9.25.
High-grade scheelite, $9.25.
Ordinary grades, $8.50@$8.75.
Market nominal.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Zinc and Lead Ore Producers Curtail Production by Two-week Shutdown

Joplin, Mo., June 28, 1924. — Zinc blende, per ton, high, $41.60; basis 60 per cent zinc, premium, $40@$41; Prime Western, $39@$40; fines and slimes, $38@$36; average settling price, all zinc ores, $38.24.

Lead, high, $84.60; basis 80 per cent lead, $80; average settling price, all lead ores, $82.47 per ton.

Shipment for the week: Blende, 11,853; lead, 1,080 tons. Value, all ores the week, $541,290.

Shipments for the half-year: Blende, 351,764; calamine, 372; lead, 44,196 tons. Value, all ores the half-year, $19,162,580.

Some mines closed last night and others will close down tonight for a holiday of two weeks over the Fourth of July. Others will close down the night of July 3. It is estimated those closing down will reduce the production 15,000 tons the next two weeks.

A premium price was bid this week for 2,000 tons of ore with high sulphur-iron content by a smelter manufacturer of sulphuric acid.

Platteville, Wis., June 28, 1924 — Blende, basis 60 per cent zinc, $42@$42.50 per ton. Lead, basis 80 per cent lead, $86.50 per ton. Shipments for the week: Blende, 717; lead, 40 tons. Shipments for the year: Blende, 14,060; lead, 532 tons. Shipments for the week to separating plants, 1,363 tons blende.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos:
Crude No. 1—$300@$425.
Crude No. 2—$175@$250.
Spinning fibers—$90@$150.
Magnesia and compressed sheet fibers—$70@$100.
Shingle stock—$50@$70.
Paper stock—$35@$40.
Cement stock—$20@$25.
Floats—$8@$12.
All per short ton, f.o.b. mines, Quebec, tax and bags included.
No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f. New York.

Barytes—Crude—$8 per ton, Missouri mines, 90@98 per cent $BaSO_4$; $9 per ton, f.o.b. Georgia mines; $6@$8, at Baltimore.
Ground—Off color, $13 per ton, Baltimore; white, $16, Baltimore.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.
Demand normal. No price change anticipated for balance of year.

Bauxite—American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.75.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign, per metric ton c.i.f.:
French, 5 per cent SiO_2, $5@$7.
Dalmatian, low SiO_2, $5@$7.50.
Other grades, $6.

Beryl—4½c. per lb. f.o.b. Connecticut points. Nominal.
$85 per ton, hand-sorted crystals, f.o.b. New York.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 4¾@5c. per lb.; in bbls., 5½c. Boric acid, 10½c.

Chalk—F.o.b. New York, per lb.:
English, extra light, 5c.
Domestic, light, 4½@4¾c.
Domestic, heavy, 3⅜@3¾c.
In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:
Crude No. 1, $7.
Crude No. 2, $6.
Washed, $8.50.
Powdered, $13@$20.
Powdered (Blue Ridge), $14@$20.
Imported English, f.o.b. American ports, as quoted on following page:

[1]Price furnished by Foote Mineral Co., Philadelphia.

Lump, $15@$20.
Powdered, $45@$50.
1A grade, domestic, $16@$18, f.o.b. mines. Good demand.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, ¼ in., $45.
Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½@4c.
Market fair to good.

Feldspar—Per long ton, f.o.b. cars, *North Carolina:*
No. 1 pottery grade, $6.50@$7.25, depending upon quality.
No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.
Some slackening in demand noticed. Prices of crude easier and shortage of supplies owing to bad weather conditions has disappeared. Market quiet.

In *Connecticut*, per net ton, f.o.b. mines:
60 to 80 mesh, $20.
150 mesh, $25.
200 mesh, $30.

In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not exceeding 10 per cent SiO_2, $8.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market better than for three months.

In *New York*, per ton, f.o.b. cars:
No. 1, $8. Demand good.

In *Maine:*
No. 1 ground, $19.

In *Tennessee:*
Pottery grades, $15.30@$21.
Tile grades, $15@$18.
Enameling grades, $11@$16.
Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.

In *Canada:*
No. 1 crude, $7 per short ton.
No. 1 ground, 180 mesh, $20.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Not less than 80 per cent CaF_2 and not over 5 per cent SiO_2, $22.
Not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $23.50.
Ground, 93 to 98.5 per cent CaF_2 and not over 3 per cent SiO_2, $35 in bulk, $39 in bags or barrels.
Acid, ground, not less than 98½ per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $49 in packages.
Market quiet.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colo.:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 5½@6c.
Ceylon chip, 4½@5c.
Ceylon dust, 2@3½c.
Crude amorphous, $15@$35 per ton.
Powdered amorphous, 4@15c. per lb.
Flake, finely ground, 3@50c.
Lubricating quality, 7@30c.
Foundry quality, 3@8c.
Market quiet and dull.

Gypsum—Per ton, depending upon source:
Crushed rock, $3@$4.50.
Ground, $3.50@$6.
Agricultural, $5@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $25 per short ton, Florida mines.

Iron Oxide—(see ocher) Ground 95 per cent through 200 mesh Standard Spanish red, $45 per ton.

Kaolin—See China Clay.

Lepidolite—$20@$30 per ton for ordinary grades.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $45.
Dead burned, $32@$34, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.
Owing to slump in construction at Los Angeles the Pacific Coast market has eased.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 6c. per lb.
Grade "AC," 7c. per lb.
Grade "AA," fine, 8c. per lb.
Grade "C," fine and lump, 9c.
Grade "C," lump, 12c.

Mica—
North Carolina prices:
Scrap, $17@$20 per ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1½ in., 7c.

1½ x 2 in., 16c.	3 x 4 in., $1.75.
2 x 2 in., 30c.	3 x 5 in., $2.
2 x 3 in., 70c.	4 x 6 in., $3.
3 x 3 in., $1.25.	6 x 8 in., $4.50.

Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
Other quality, 28 to 120 mesh, $29.50 @$65 per ton.

In *New Hampshire:*
Washer and disk, $280 per ton.
Scrap, $24 per ton.

[1]**Monazite**—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines.

Ozocerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 26@27c.
Green, 170 deg. melting point, 28 @29c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $5.75.
75 per cent, $5.50.
74@75 per cent, $5.25.
70 per cent, $3.50.
68 per cent, $3.25.
In *Tennessee*, per long ton:
75 per cent hand mined lump, $6.50.
75 per cent washed lump, $6.75.
72 per cent washed run of mine, $5.50.
65 per cent ground 95 per cent through 100 mesh, $6.50 per short ton.
Market fair.

Potash—Contract prices, per ton:
Kainit, 14@16 per cent, $7.33.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 11c.
Fines, through ½ in., 11½c.
Cinder from ore to remain property of buyers.
Market dull, majority of fertilizer plants shut down.

Quartz Rock Crystals — Colorless, clear and flawed, pieces, ¼ to ½ lb. in weight, 40c. per lb. in ton lots.
For optical purposes, double above prices.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, 12c., Florida, delivered.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
450 mesh, $31.
350 mesh, $25.
200 mesh, $20.
100 mesh, $8.
Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25.

Spodumeme—$20@$30 per ton, depending upon lithium content.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—Per ton, in 50 lb. paper bags, *Vermont* mills, carloads:
Ground, 200 mesh, extra white, $10.50.
Ground, 180 mesh, medium white, $10.
Ground, 160 mesh, medium white, $9.50.
Demand shows signs of improvement after a quiet period of nearly two months. Prices firm.

In *New York*, double air-floated, including containers:
200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand good.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:
White, $12@$15.
Grayish white, $8@$10.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:

Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.

Double ground:
Rose and cream, $17@$25.
White, $19@$30.

Air-float:
Rose and cream, $25@$30.
White, $35.
Market steady.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—7¾@8c. per lb. Demand considerably improved for delivery over balance of year.

Copper Sulphate—4.60@4.70c. per lb.

Potassium Sulphate—Basis 90 per cent, $45.85 per ton.

Sodium Nitrate—$2.35@$2.65 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$18@$21 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7⅞c.
5 per cent lead sulphate, 7½c.
10 to 35 per cent lead sulphate, 7c.
French, red seal, 9⅜c.
French, green seal, 10⅜c.
French, white seal, 12c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 11½c. per lb.

Ferromanganese — Domestic, 78@82 per cent, $107.50 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $35@$37, f.o.b. furnace; 16@19 per cent, $34@$36.

Ferromolybdenum—$2 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $39.50 @$43.50 per gross ton, f.o.b. works; 50 per cent, $75 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 90@93c. per lb. of contained W, f.o.b. works. Quiet.

[1]**Ferro-uranium**—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium — $3.50@$4 per lb. of V contained, f.o.b. works.

Metal Products

Rolled Copper—Sheets, 19½c.; wire, 14¾c.

Lead Sheets—Full lead sheets, 10⅜c. per lb.; cut lead sheets, 11c. in quantity, mill lots.

Nickel Silver—26½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 17¼c. per lb.; rods, 14¼c. per lb.

Zinc Sheets—9½c. per lb., f.o.b. works.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$45@$47 per net ton, f.o.b. shipping point.

Firebrick—First quality, $42@$45 per M., Ohio and Kentucky works; $42@$45 Central Pennsylvania; second quality, $35@$38.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$38@$40 per M. Pennsylvania; $48@$50 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

Iron Trade Continues Quiet

Pittsburgh, July 1, 1924 — Finished steel prices are holding quite well, no material change having occurred in the past week. Mills are governed largely by costs, which are higher with the light operation, while individual orders are numerous and small.

Pig Iron—The market has shown no developments of importance in the week. Bessemer is off 50c. to $20.50, Valley, basic remaining practically nominal at $19, Valley, with foundry at $19 to $19.50, Valley.

Connellsville Coke—With $3.25 hardly more than an asking price lately on furnace coke, two lots for July, 6,000 and 9,000 tons respectively, have gone at $3. Foundry is easy at $4.50@$5. Two very good brands can now be bought on contract at $5.

Copper Market Affected by Slight Overproduction

By Felix Edgar Wormser
Assistant Editor

LITTLE COMPLAINT is heard among copper producers about the amount of copper moving into consumption. In fact, the statistics that have appeared monthly since the beginning of the year have been most encouraging, and show that electrical and other industries in the United States have been using the metal at a rate close to domestic production and at times above it. Then what is wrong with the market? Briefly, overproduction. Agreement is almost unanimous on that score, and, further, that overproduction is slight. The surplus copper produced has been great enough, however, to keep the price of the metal from moving to a plane commensurate with the general commodity price level.

The fact that it would take only a small decrease in output to have a helpful effect upon prices has probably deterred some mining companies from curtailing production. They have left it for the other fellows to do. Despite the frequent rumors of reduction in output by various important companies, copper production remains high—more than 130,000,000 lb. per month from domestic mines alone. If production should maintain this pace for the remainder of 1924, the year's output will amount to 1,560,000,000 lb., a higher rate than in 1923—a banner year for peace time.

Why do not copper-mining companies decrease their output as the pig-iron producers do when demand falls off? The answer is that demand has not fallen in the copper market as it has in the pig-iron market. Should it do so copper-mining companies would be forced to make a sharp decrease in production. While business is fair they evidently intend to maintain their present rate.

Of the ten leading copper-producing companies of the world only one is controlled by other than American capital, the fourth on the list following—Union Minière du Haut Katanga—the remarkable copper mine in the heart of Africa now producing at the rate of 70,000 tons per year.

Monthly Production of the Ten Leading Copper Mining Companies

	Pounds (Estimated
1. Utah Copper Co.	19,500,000
2. Chile Copper Co.	16,000,000
3. Anaconda Copper Mining Co.	15,000,000
4. Union Miniere du Haut Katanga	13,500,000
5. Braden Copper Co.	12,000,000
6. Phelps Dodge Corporation	11,000,000
7. United Verde Copper Mining Co.	8,500,000
8. Cerro de Pasco Copper Corporation	8,000,000
9. Inspiration Copper Mining Co.	7,500,000
10. Calumet & Hecla Consolidated Copper Mining Co.	7,000,000

If this table were based upon the maximum output of each company, the order would be different. It is not only the present rate of production but the potential output of world copper-mining companies that keeps copper prices low. Even a small curtailment of production on the part of the great corporations listed above would have a beneficial influence on the market. At present copper-mining companies seem to be playing individual and extraordinarily competitive rôles in the copper market. It looks like a relentless struggle—a tough one for the vein mines whose costs are admittedly higher than those of the porphyries. The cry of some domestic producers against South American copper production is really raised against the activities of American capital abroad, a most unusual situa-

tion so far as commercial developments in the trade of the United States are concerned.

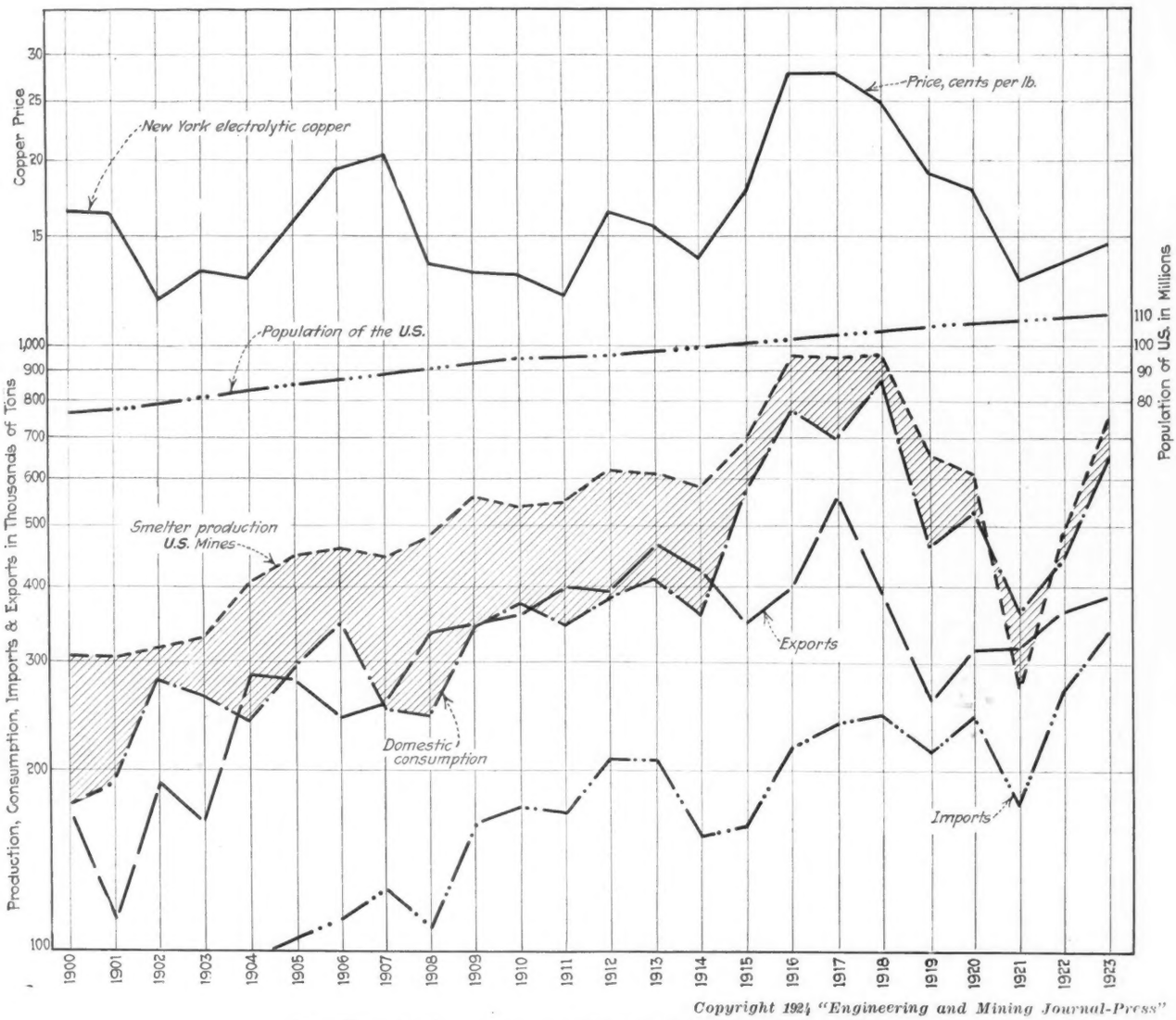
Below is a curve which shows the growth and principal features of the domestic copper industry since the beginning of the twentieth century. The curves are plotted upon semi-logarithmic paper, which has the peculiarity of showing rate changes better than ordinary cross-section paper. Lines of equal inclination on logarithmic paper have equal rates of change.

Some important deductions can be made from an inspection of these curves. It will be noted that smelter production of copper has increased at a rate faster than the population of the United States. Also, that with the exception of one unusual year, domestic consumption of copper has always been less than domestic production. The shaded area indicates the spread between these two curves. Readers so inclined may speculate upon the future trend of the two.

Some observers think the day is not far distant when domestic consumption will eclipse domestic production. At that time, of course, a tariff could be made effective. It is also instructive to note that yearly exports of copper have been larger than imports, but that the ratio of exports to imports is becoming smaller, owing partly to a halt in the growth of shipments to Europe and partly because of the heavier imports.

Copper producers are pinning their faith on an improved market, in some measure upon a stronger demand from abroad, especially after the Dawes report is put into execution. Political uncertainties still darken the European situation, however, and an early settlement is too much to expect. Reports from Germany indicate that labor costs are now about 80 to 90 per cent of pre-war rates, which is a sign of the competition which industries in other countries must expect once the German machine runs regularly again and consumes more copper. When that day arrives the raw-material producing industries—copper among them—should profit, and the manufacturing industries, which had such a fine time of it in 1923, may find sledding rougher.

One would think that at prices of copper below 13c.—the metal can be obtained for 12½c., delivered, today—producers would not be overanxious to book business. Nevertheless, the scramble for existing orders has been exceedingly keen. Occasionally the activity of an anxious seller has been enough to unsettle confidence in the market. Not so many weeks ago one producer negotiated with a large manufacturer for a 5,000-ton order of copper, agreeing to give it to the manufacturer at a ⅛c. concession below the general market level. Despite every precaution taken to keep the transaction secret, the news of this deal soon leaked out—as it always does—and was known to the trade the next day. Ordinarily, the removal of such a large tonnage from the market might have a stimulating effect upon prices. On the contrary, in this particular instance the market immediately fell to the level of this large transaction, and neither producer nor consumer benefited by the cutting which had taken place. This is one reason why the price of copper moves violently from time to time.



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The Trend of the Copper Mining Industry Since 1900

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1923	1924	1923	1924	1923	1924
January	65.668	63.447	31.928	33.549	465.053	425.524
February	64.313	64.359	30.875	33.565	468.631	430.457
March	67.556	63.957	32.310	33.483	469.269	428.769
April	66.855	64.139	32.346	33.065	465.220	434.788
May	67.043	65.524	32.611	33.870	462.252	435.716
June	64.861	66.690	31.611	34.758	461.132	431.675
July	63.015	.....	30.942	.....	458.025	.....
August	62.793	.....	30.952	.....	455.714	.....
September	64.203	.....	31.698	.....	453.901	.....
October	63.649	.....	31.718	.....	452.024	.....
November	63.818	.....	32.774	.....	437.839	.....
December	64.705	.....	33.375	.....	435.500	.....
Year	64.873	.....	31.929	.....	457.047	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, ponce per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1923	1924	1923	1924	1923	1924
January	14.510	12.401	64.494	61.273	71.409	67.193
February	15.355	12.708	67.700	63.113	74.500	68.167
March	16.832	13.515	73.851	66.137	81.464	72.087
April	16.663	13.206	73.169	64.338	81.331	70.150
May	15.440	12.772	67.460	62.006	76.568	67.648
June	14.663	12.327	66.607	61.375	73.238	66.313
July	14.321	.....	65.278	.....	72.364	.....
August	13.822	.....	64.034	.....	70.000	.....
September	13.323	.....	63.194	.....	68.275	.....
October	12.57?	.....	60.614	.....	64.250	.....
November	12.727	.....	61.648	.....	66.477	.....
December	12.823	.....	62.035	.....	67.611	.....
Year	14.421	.....	65.840	.....	72.291	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1923	1924	1923	1924	1923	1924
January	7.633	7.972	7.571	8.002	27.119	31.528
February	8.050	8.554	8.093	8.643	28.519	34.589
March	8.252	9.013	8.254	8.891	28.815	37.161
April	8.101	8.263	7.996	7.932	26.956	32.819
May	7.306	7.269	7.085	6.973	25.614	29.426
June	7.146	7.020	6.852	6.848	25.429	32.138
July	6.237	.....	6.126	.....	24.188	.....
August	6.582	.....	6.496	.....	24.222	.....
September	6.856	.....	6.700	.....	25.688	.....
October	6.831	.....	6.570	.....	27.815	.....
November	6.846	.....	6.582	.....	30.352	.....
December	7.369	.....	7.369	.....	31.042	.....
	7.267	.....	7.141	.....	27.147	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1923	1924	1923	1924	1923	1924
January	37.986	48.250	39.173	48.750	181.852	246.790
February	40.693	52.772	42.011	53.272	190.513	272.399
March	46.569	54.370	48.569	54.870	219.607	277.429
April	44.280	49.457	45.810	49.957	213.081	250.863
May	42.346	43.611	43.135	44.111	203.097	218.511
June	40.375	42.265	40.957	42.765	191.798	219.219
July	37.970	.....	38.490	.....	181.188	.....
August	38.841	.....	39.269	.....	186.705	.....
September	41.047	.....	41.547	.....	198.263	.....
October	41.322	.....	41.851	.....	203.957	.....
November	43.495	.....	43.995	.....	220.710	.....
December	46.662	.....	47.160	.....	235.007	.....
Year	41.799	.....	42.664	.....	202.148	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1923	1924	1923	1924
January	6.815	6.426	35.733	34.761
February	7.152	6.756	35.613	36.518
March	7.706	6.488	36.720	35.298
April	7.197	6.121	34.275	32.588
May	6.625	5.793	31.057	30.648
June	6.031	5.792	29.548	31.788
July	6.089	.....	29.335	.....
August	6.325	.....	32.386	.....
September	6.438	.....	33.469	.....
October	6.293	.....	32.995	.....
November	6.347	.....	32.949	.....
December	6.260	.....	32.611	.....
Year	6.607	.....	33.058	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1923	1924	1923	1924	1923	1924	1924
January	6.884	10.279	72.731	59.500	112.462	122.115	115.500
February	7.290	10.935	70.636	59.565	113.273	124.739	115.935
March	8.885	11.442	70.808	64.269	110.846	121.692	113.231
April	8.380	9.952	69.200	74.308	116.840	115.577	108.077
May	7.477	8.755	68.000	76.962	115.007	115.731	112.192
June	6.839	8.403	67.769	73.720	115.615	116.000	113.000
July	7.097	.....	66.980	.....	116.000	.....	.....
August	7.753	.....	65.212	.....	116.000	.....	.....
September	7.633	.....	63.000	.....	116.000	.....	.....
October	8.005	.....	61.769	.....	116.923	.....	.....
November	9.156	.....	61.917	.....	124.479	.....	.....
December	9.365	.....	60.000	.....	125.000	.....	.....
Year	7.897	.....	66.502	.....	116.537	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1923	1924	1923	1924	1923	1924
January	29.27	24.76	27.35	23.76	28.77	23.88
February	29.79	25.26	28.15	23.76	27.21	25.06
March	32.03	25.14	31.79	23.76	31.77	24.7o
April	32.77	24.56	32.77	23.26	32.77	23.80
May	31.87	23.89	29.83	22.08	32.46	22.91
June	30.27	.....	28.34	.....	29.81	.....
July	28.47	.....	26.52	.....	27.47	.....
August	28.27	.....	26.77	.....	26.77	.....
September	28.26	.....	26.26	.....	26.72	.....
October	26.96	.....	25.01	.....	25.52	.....
November	24.79	.....	22.57	.....	23.60	.....
December	24.54	.....	22.62	.....	23.72	.....
Year	28.94	.....	27.33	.....	28.05	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1924			
	February	March	April	May
Alaska shipments	8,248,221	9,388,162	6,538,827	6,375,469
Calumet & Arizona	2,824,000	2,084,000	3,330,000	3,332,000
Miami	4,965,000	5,311,000	5,163,000	5,314,000
New Cornelia	4,452,402	5,875,334	5,472,542	4,505,996
Old Dominion	2,250,000	2,100,000	2,071,000	2,000,000
Phelps Dodge	10,112,000	10,597,000	10,673,000	10,577,000
United Verde Extension	3,901,444	3,302,766	3,809,584	3,500,000
A.S. & R. & Tenn. Copper	16,200,000	14,000,000	17,000,000	17,500,000
Imports: Ore and concentrates, matte	17,317,820	9,479,348	11,577,799	16,882,662
Partly from				
Chile	4,795,426	5,685,837	1,650,196	4,737,728
Cuba	1,776,580	.....	1,792,000	1,848,000
Canada	5,824,253	665,007	2,969,892	2,443,598
Mexico	2,084,880	2,316,464	2,362,198	3,458,972
Imports of black and blister, unrefined	37,994,544	47,332,796	31,688,505	36,563,022
Partly from				
Chile	9,552,381	13,396,214	7,013,143	14,657,052
Peru	5,073,385	12,413,463	2,428,445	4,302,661
Africa	6,090,290	9,231,241	9,630,942	.....
Mexico	5,008,783	5,808,720	7,082,030	6,286,999
Imports of refined and old	13,133,379	8,718,668	10,318,440	8,970,467

Foreign

Boleo, Mexico	1,356,075	1,454,198	976,815	1,801,485
Falcon Mines, Rhodesia	494,800	504,952	500,000	.....
Furukawa, Japan	2,939,214	3,416,954	.....	.....
Cons. M & S., Canada	.....	.....	.....	400,000
Granby Cons., Canada	2,934,214	3,977,000	3,229,788	2,892,869
Katanga, Africa	11,243,295	13,496,805	13,902,525	13,940,010
Mount Morgan, Aust	702,000	440,000	682,000	.....
Mount Lyell, Aust	884,000	1,322,000	484,000	.....
Phelps Dodge Mexican	2,983,000	3,047,000	3,175,000	2,547,000
Sumitomo, Japan	2,806,044	2,485,976	.....	2,394,132
Wallaroo & Moonta, Aust	(a)	(a)	(a)	(a)

Comparative U. S. Copper Mine Production

	1921	1922	1923	1924
January	90,596,597	32,010,292	112,267,000	133,356,000
February	86,682,941	45,957,530	102,725,000	128,260,000
March	91,046,345	55,705,760	121,562,000	129,816,000
April	46,946,523	76,601,000	118,157,000	131,928,000
May	25,310,511	88,714,000	125,438,000	131,054,000
June	24,623,693	93,740,000	125,479,000	.....
July	22,033,739	91,000,000	125,249,000	.....
August	23,248,398	101,188,000	131,088,000	.....
September	23,855,316	96,408,000	124,523,000	.....
October	23,231,572	103,273,000	132,481,000	.....
November	28,341,442	102,845,000	127,963,000	.....
December	26,629,137	103,003,000	129,354,000	.....

(a) Not available.

Mining Stocks

Week Ended June 28, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*10		
Anaconda	New York	31⅛	27¼	30¾	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	*90	*90	*90		
Ariz. Com'l.	Boston	8½	8¼	8½	Ja.15, Ja.31	0.50
Calaveras	N. Y. Curb			1½		
Calumet & Arizona	Boston	45	43½	45	Jn. 6, Ju. 23 Q	0.50
Cal. & Hecla (New)	Boston	15	14¾	15	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	3½	3	3½		
Cerro de Pasco	New York	47½	45½	47½	Ap. 17, My. 1	1.00
Chile Copper	New York	28⅛	27⅛	28⅛	Jn.2, Jn.30, Q	0.62½
Chino	New York	17⅛	17	17⅜	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	2⅜	2⅛	2⅜		
Copper Range	Boston	22	19¾	21¾	May, 1923	1.00
Crystal Copper	Boston Curb	*56	*56	*56		
Davis-Daly	Boston	*45	*45	*45	Mar., 1920	0.25
East Butte	Boston	4½	3¾	4 7/16	Dec., 1919	0.50
First National	Boston Curb	*30	*30	*30	Feb., 1919,	0.15
Franklin	Boston	†*37				
Gadsden Copper	Boston Curb	*70	*70	*70		
Granby Consol.	New York	14⅜	13½	14⅜	May, 1919	1.25
Greene-Cananea	New York	11½	11¼	11⅜	Nov., 1920	0.50
Hancock	Boston	*75	*75	*75		
Howe Sound	N. Y. Curb	2⅛	1⅞	1⅞	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	24	23	24	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	*2¾	*2½	*2¾	May, 1923	0.15
Isle Royale	Boston	13	12	13	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	*90	*90	*90		
Jib Consol.	N. Y. Curb	*48	*42	*46		
Kennecott	New York	40⅞	39½	40¾	Jn.6, Jy. 1, Q	0.75
Keweenaw	Boston	†*65				
Lake Copper	Boston	1¼	1	1		
Magma Copper	New York	28	26½	27½	Jan., 1919	0.50
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	*50	*50	*50	Nov., 1917	1.00
Miami Copper	New York	21⅛	20⅛	20⅜	My.1, My.15, Q	0.50
Mohawk	Boston	26½	24⅛	26⅛	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	7	6⅝	7	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	13¾	13	13¾	Sept., 1920,	0.25
New Cornelia	Boston	18	18	18	My.9, My.26,	0.25
New Dominion	N. Y. Curb			2½		
North Butte	Boston	4½	4	4	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	*99	*91	*99		
Old Dominion	Boston	17⅛	17⅛	17⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†106	†101		Jn.21, Jy.2 Q	1.00
Quincy	Boston	15½	14	15⅜	Mar., 1920	1.00
Ray Consolidated	New York	10⅝	10	10⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*12	*12	*12		
St. Mary's Min. Ld.	Boston	27	27	27	Ap.22, My.20	3.00
Seneca Copper	New York	7/8	3/4			
Shannon	Boston	*75	*45	*75	Nov., 1917	0.25
Shattuck Arizona	New York	5¼	4¾	5¼	Jan., 1920	0.25
Superior & Boston	Boston	*75	*60	*75		
Tenn. C. & C. cfs.	New York	7	6⅞	7	De.31, Ja.15, Q	0.25
Utah Copper	New York	70⅞	68¼	70¾	Jn.13, Jn.30,	1.00
Utah Metal & T.	Boston	*20	*20	*20	Dec., 1917	0.30
Victoria	Boston	†*50				
Walker Mining	N. Y. Curb	3	3	3		
Winona	Boston	*16				
NICKEL-COPPER						
Internat. Nickel	New York	15⅛	14½	15⅛	Mar., 1919	0.50
Internat. Nickel pfd.	New York	83	83	83	Ap.17, My.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2⅜	2⅜	2⅜		
National Lead	New York	146½	141½	145¾	Jn.13, Jn.30, Q	2.00
National Lead pfd.	New York	113⅞	112⅜	113⅜	My. 23, Ju. 14, Q	1.75
St. Joseph Lead	New York	26¼	25¾	26	Se. 9, Se.20	0.50
ZINC						
Am. Z. L. & S.	New York	8	8	8	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	27	27	27	Nov., 1920	1.50
Butte C. & Z.	New York	4⅜	3⅝	4⅛	Mar., 1923	0.50
Butte & Superior	New York	15½	14⅛	15⅜	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	3⅜	3¼	3¼	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	141¼	140 3/4	141¼	May 10, 1924	2.00
United Zinc	N. Y. Curb			*25		
Yellow Pine	Los Angeles	65	65	65	June, 1924	0.04
SILVER						
Alvarado	N. Y. Curb	1⅛	1	1⅛		
Beaver Consol.	Toronto	†*17	†*17	*16½	May, 1920	0.03
Castle-Trethewey	Toronto	*66½	*65	*65		
Coniagas	Toronto	†2	†2	1.75	Ap.20, My.1	0.02½
Crown Reserve	Toronto	†*55	†*54½	*53½	Jan., 1917	0.05
Keeley	Toronto	†2.38	†2.28	2.25		
Kerr Lake	N. Y. Curb			1⅝	Ap.1, Ap.15, Q	0.12
La Rose	Toronto	*10	*10	*10	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	†1.40	†1.39	1.38		
McKinley-Dar.-Sav.	Toronto	*11	*11	*11	Oct., 1920	0.03
Mining Corp. Can.	Toronto	†2.75	†2.75	2.70	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6¼	6	6¼	Jn.30, Jy.21, Q	0.15
Ontario Silver	New York	6	6	6	Jan., 1919	0.50
Temiskaming	Toronto	21	21	21	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	*17	*12½	*17		
Alaska Juneau	New York	1¼	1¼	1¼		
Argonaut	Toronto	†*48	†*47½	47		

Stock	Exch.	High	Low	Last		Last Div
Carson Hill	Boston	†1½				
Cresson Consol. G	N. Y. Curb	3⅜	3⅛	3⅛	Mc.3, Ap.10, Q	0.10
Dome Mines	New York	17¼	16¼	16⅜	Jn.26, Jy.21, Q	0.50
Golden Cycle	Colo. Springs			1.28½	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	†13.10	†13.05	13.25	Jn.26, Jy.14, M	0.05
Homestake Mining	New York	41½	37	37	Jn.20, Jy.25,	0.50
Kirkland Lake	Toronto	*18⅜	*18½	*18⅜		
Lake Shore	Toronto	3.70	3.68	3.68	My.2, My.15	0.02
McIntyre-Porcupine	New York	16	15⅝	15⅝	Ap. 1, My. 1,	0.25
Newray	Toronto	*23½	*23½	*23½		
Portland	Colo. Springs			58	Oct., 1920	0.01
Teck-Hughes	Toronto	†1.11	†1.06	1.14		
Tom Reed	Los Angeles	38½	34½	34½	Dec., '1919	0.02
Tough-Oakes	Toronto	*61	*60½	*61		
United Eastern	N. Y. Curb	*47	*39	*39	Ap 10, Ap.28, Q	0.10
Vipond Cons.	Toronto	†1.06	†1.05	1.03		
Wright-Hargreaves	Toronto	3.40	3.35	3.40	Jn.16, Jy. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	*82	*79	*82		
Con. Cortez	N. Y. Curb	*20	*10	*12		
Con. Virginia	San Francisco	4	2½	2½		
Continental Mines	N. Y. Curb	2¼	1¾	2		
Dolores Esperanza	N. Y. Curb			*50	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2½	1¾	2	Jn.19, Jy.2	0.08
Tonopah Belmont	N. Y. Curb	*55	*52	*52	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*24	*24	*24	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2½	2 7/16	2 7/16	Jn. 10, Jy. 1	0.05
Tonopah Mining	N. Y. Curb	1⅜	1⅜	1⅜	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	*75	*75	*75		
West End Consol.	N. Y. Curb			*35	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*50	*50	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	5¾	5⅝	5¾	Jn.16, Jy. 2, X	0.15
Bingham Mines	Boston	16	15⅝	16	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	*76	*74	*74	Dec., 1920	0.15
Chief Consol.	Boston Curb	3¼	2½	2⅝	Ap 19, My. 1, Q	0.10
Columbus Rexall	Salt Lake	19	18	18	Aug., 1922	0.03
Consol. M. & S.	Montreal	39	37½	39	Jn.30, Jy.15	0.75
Daly Mining	Salt Lake			205	July, 1920	0.10
Erupcion	Boston Curb	2½	2¼	2½	Jn. 16, Jy. 2, X	0.15
Federal M. & S.	New York	9	9	9	Jan., 1909	1.50
Federal M. & S. pfd.	New York	49½	44½	48⅜	My.26, Jn.15, Q	1.75
Florence Silver	Spokane	10	10	10	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb			8⅛	My.15, Jn.15,	0.25
Iron Blossom Con.	N. Y. Curb			*26	Oct., 1923	0.02
Marsh Mines	N. Y. Curb	*6	*5	*5	June, 1921	0.02½
Park City	Salt Lake	3.75	3.75	3.75	Jn.14, Jy.1,	0.15
Park Utah	N. Y. Curb			3½	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake	*8	*8	*8	Nov., 1917	0.02
Silver King	N. Y. Curb	*50	*50	*50	Jn.20, Jy.1, Q	0.15
Silversmith	Spokane	*35	*34	*34	Jy.1, Jy. 10,	0.01
Tamarack-Custer	Spokane	1.50	1.40	1.40	Jn.25, Jn.30,	0.02
Tintic Standard	Salt Lake	4.35	4.35	4.35	Jy.28, '24, X	0.25
Utah-Apex	Boston	2¼	2	2	June, 1923,	0.50
IRON						
Bethlehem Steel	New York	47	45	45½	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	7/16	3/16	1/16		
Char. Iron pfd.	Detroit			1		
Colorado Fuel & Iron	New York	47½	43½	45½	My.10, My.26 Q	2.00
Col. Fuel & Iron pfd.	New York			102	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	27½	27	27⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb			46	My.15, Jn.1 Q	0.62½
Mesabi Iron	N. Y. Curb			2¾		
Replogle Steel	New York	10⅞	7½	10¼		
Republic I. & S.	New York	47¾	45⅝	47½	May, 1921	1.50
Republic I. & S. pfd.	New York	86	84	86	Jn.14, Jy.1, Q	1.75
Sloss-Sheffield S.&I.	New York	58⅛	54½	58⅞	Jn.6, Jn.20, Q	1.50
Sloss-Shef. S.&I. pfd.	New York			82	Jn.18, Jy.2, Q	1.75
U. S. Steel	New York	100¼	96¼	99¼	Jn.1, Jn.28 QX	1.75
U. S. Steel pfd.	New York	121⅞	121¼	121⅛	My.6, My.29, Q	1.75
Virginia I. C. & C.	New York			38	De.15, Ja. 2	1.50
Virginia I.C.&C. pfd.	New York	71	71	71	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	23	21½	23	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*25	*20	*23		
ASBESTOS						
Asbestos Corp.	Montreal	24	19	24	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	60	57	60	Jy.1, Jy.16, Q	1.50
SULPHUR						
Freeport Texas	New York	9	8½	8½	Nov., 1919,	1.00
Texas Gulf	New York	66⅛	64⅝	65⅝	My.31, Jn.14 QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3	3	3		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	43	40⅛	43	My. 20, Jn.1, Q	0.75
Amer. Metal pfd.	New York			110½	My. 20, Jn.1, Q	1.75
Amer. Sm. & Ref.	New York	65½	63⅜	65⅛	Jy.11, Au.1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	101	100	101	Au. 8, Se. 1,	1.75
U. S. Sm. R. & M.	New York	22¼	20½	22¼	Jan., 1921,	0.50
U.S. Sm. R.&M.pfd.	New York	40	39¾	40	Jy.7, Jy.15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial, X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Movsey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.